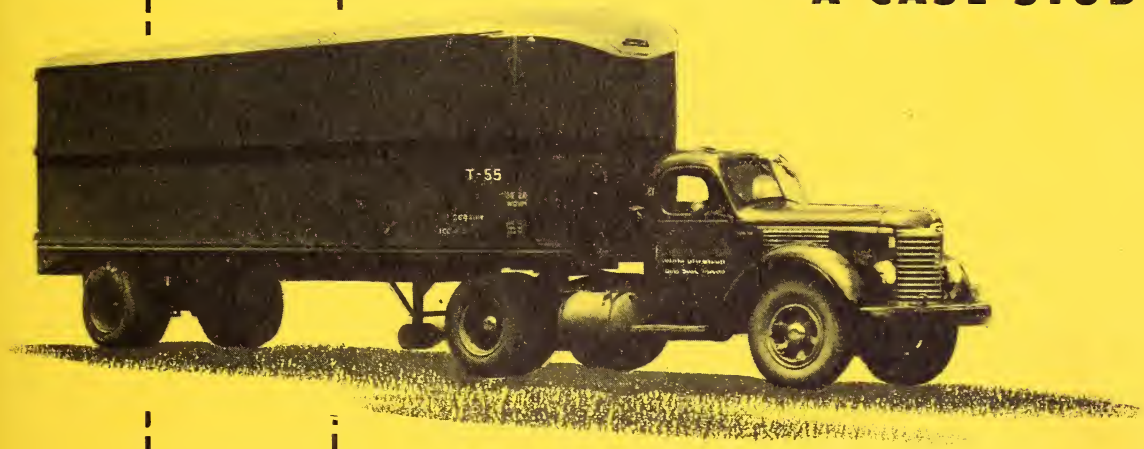
Improving the TRUCK DELIVERY Operations of a WHOLESALE GROCER

A CASE STUDY



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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL MARKETING SERVICE

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ACKNOWLEDGMENTS

To the managers of the Baltimore wholesale grocery firm on which this case study is based, appreciation is expressed for advice and assistance during the planning and carrying out of the study. They made the facilities and operations of the firm available for observation, gave access to accounting data, and helped in numerous other ways. The International Brotherhood of Teamsters, Chauffeurs, Warehousemen, and Helpers of America, at both the national and the local levels, also deserves much credit for cooperation. Special acknowledgment is due the firm's truck drivers and helpers. Without their cooperation, this report could not have been written.

CONTENTS

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SUMMARY

The efficiency of delivery operations of an independent wholesale grocery firm in Baltimore, Md., was studied in July, August, and December 1954. The firm made deliveries of dry groceries to rural customers within a radius of 45 miles of Baltimore, as well as to those within the city. City deliveries were made by 6 straight trucks, and rural deliveries by 5 truck-tractors and 9 semitrailers, semitrailers on certain routes being alternated. Suggestions for reducing costs of the operations based upon time and cost analyses are made for deliveries in both areas.

The cost of delivering small orders was of particular significance. The average cost of delivering orders of less than $25 to customers in rural areas was 18½ cents, or about 10½ cents more per dollar of sales than the gross profit of the firm, approximately 8 cents. On orders of that same size to urban and congested urban areas and for orders of $25 to $75 in value to rural areas, delivery costs ranged from 5 to 6 cents per dollar of sales. It seems very probable that here, too, the wholesaler lost money. It is recommended that the firm review the servicing of orders up to $75. The results of this review may show that these small orders should be: (a) Sold on a cash-carry basis only; (b) consolidated--with less frequent deliveries as a result; (c) subjected to a delivery charge; or (d) declined entirely, if below a specified minimum size. In making this analysis, the wholesaler should determine whether any of these small orders are purchased by the same retailers who frequently purchase large orders. In addition, the wholesaler should determine whether any of his small customers have a growth potential. If either or both of these circumstances occur, the delivery charge could be waived for those particular customers.

Labor expense of c.o.d. orders on 1-driver deliveries was 18 percent, and on driver-helper deliveries 51 percent, higher than for charge orders because of the time spent in making collections. A review of policy on c.o.d.'s is suggested, particularly on orders of low value and those delivered to rural areas. The wholesaler should also take into account the relative costs of handling the low-value orders in the office and plant.

Suggested improvements in trip routing include: Up-to-date reporting, by drivers to dispatchers, of changes in streets and highways that slow down deliveries or might be used to speed them up; periodic review by dispatchers of existing routes to balance out overall route delivery times by reallocating customers between routes requiring less than 8 hours, and those requiring more than 9. In a typical week, 5 drivers and 3 helpers on predominantly rural routes put in 71¼ overtime hours more than the minimum guarantee, while 5 drivers and 1 helper on other routes put in less than the guaranteed overtime.

An improved method of loading and unloading orders would reduce the time spent by drivers or helpers in the unloading operation. Tests of this system showed 50 percent savings in unloading time.

The type of equipment used has an important bearing upon delivery costs. Doors on both sides, as well as in the rear, of delivery trucks would save driving time and mileage by avoiding the out-of-route circling which was necessary to present the right-hand side of the truck to the retailer's door or platform. The replacement of a heavy movable tailgate and short rear doors on one of the trailers with a permanently suspended tailgate and flush doors would save considerable time and effort on the part of the driver and helper in opening and closing up the trailer.

In addition, the trailers used on rural routes were of larger capacity than necessary for the deliveries made during the periods covered by the study. They were of 17.5 to 18 tons carrying capacity, when trailers of 12-ton capacity would have been sufficient for the orders carried. It is suggested that the firm consider the use of smaller trailers when the time comes for replacement.

IMPROVING THE TRUCK DELIVERY OPERATIONS OF A WHOLESALE GROCER - A CASE STUDY

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INTRODUCTION

Wholesale grocery firms are confronted with the problem of increasing costs in their handling and delivery operations. These increasing costs are of concern not only to wholesalers, but also to consumers and to producers. Increased marketing costs wherever they occur in the distribution channel may be reflected in lower returns to growers, lower profits to distributors, and higher prices to consumers.

In recognition of this problem, this time study and cost analysis of the delivery operations of an independent wholesale grocery firm in Baltimore, Md., was undertaken. It is the first of a series of case studies designed to develop (1) less costly methods for delivering groceries, and (2) principles and methods which may be used by wholesalers in determining the relative profitability of delivering orders of varying size. Data from the Baltimore study will be supplemented by similar studies of other wholesale firms. A comparative analysis will then be made of the several delivery operations.

RESEARCH PROCEDURE

The Baltimore wholesale grocery firm analyzed in this study does an annual business of approximately $5-$6 million. The national average for grocery wholesalers is approximately $1½ million a year. The merchandise handled by the firm consists of dry groceries, and includes canned meats and a few drug and hardware items. It does not handle fresh meat or produce. The major portion of the area served by its trucks lies within a 45-mile radius of Baltimore. Deliveries to areas outside of this radius, which are made by contract haulers, were not included in this study. The firm sells to institutions (hospitals and schools) as well as to hotels, restaurants, and retail stores.

Deliveries within Baltimore are made on a weekly basis. Deliveries to rural areas are also generally made weekly although a few routes receive delivery service every other week.

The particular Baltimore firm was selected for study because of its location and the scope of its operation. Information also indicated that the efficiency of the firm's wholesaling operation was reasonably representative

of independent grocery wholesalers doing about the same volume of business. The field work was done in 1954 during the months of July, August, and December. The research procedure consisted in: (1) making a time study analysis of the various components of the delivery operation from the time the trucks left the wholesaler's warehouse until their return; (2) interviewing the truck drivers and helpers during the time study to determine where improvements could be made in the operations; and (3) computing labor and non-labor operating expenses for each of the delivery trucks. This information was then used to determine the costs of delivering orders of varying size to different types of delivery areas.

The delivery operation, as covered by this report, begins when the truck leaves the warehouse and ends when it gets back to the warehouse. This operation consists chiefly in over-the-road movement of the merchandise, unloading, checking of the unloaded merchandise, cash collections, and the return run to the warehouse.

The author obtained the time study data for each of the trips analyzed by riding in the truck and maintaining a record of the successive delivery operations by means of a stop watch. Through riding with the crew, he obtained extensive information about the operations and the problems involved. At each stop, his observations both on the ground and in the retail store not only gave him the precise time data but also afforded an opportunity to evaluate the operations.

Nineteen trips were analyzed during the period of study. The routes traveled were: 3 congested urban, 4 "other urban," 8 rural, and 4 combination routes--congested urban and other urban, or other urban and rural. The trips were classified as follows:

Congested urban	the heavily-congested central area of Baltimore.
Other urban	the remaining Baltimore area.
Rural	the area outside the city limits of Baltimore.

The routes analyzed make up 50 percent of the total routes of the firm over which delivery is made in its own trucks.

The management of the firm assisted in the selection of the routes. The selection was designed to facilitate comparisons of 1-man and 2-man delivery operations, delivery operations by type of equipment, by type of route, by basis of order--c.o.d. vs. charge--and by type of customer.

EQUIPMENT

The firm owns and operates 6 straight trucks, 5 truck-tractors, and 9 semitrailers. No full trailers are used in the operation--that is, truck-trailers so constructed that nearly all of their weight and load rests upon their own wheels. The age of the vehicles varies from 1 to 6 years in the case of straight trucks, from 2 to 4 years for truck-tractors, and from 7 to 15 years for the semitrailers. The tractors are all of the same make, while the straight trucks are of 4 different makes. The tractor-semitrailers employ both a driver and a helper, while 5 of the 6 straight trucks usually have only a driver. (Figs. 1 and 2.) The remaining straight truck, which has a load capacity substantially greater than the others, also has a driver and a helper.

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Figure 1.--Because of its maneuverability this type of vehicle--a straight truck--is used by the grocery wholesaler for deliveries largely within the city limits of Baltimore.

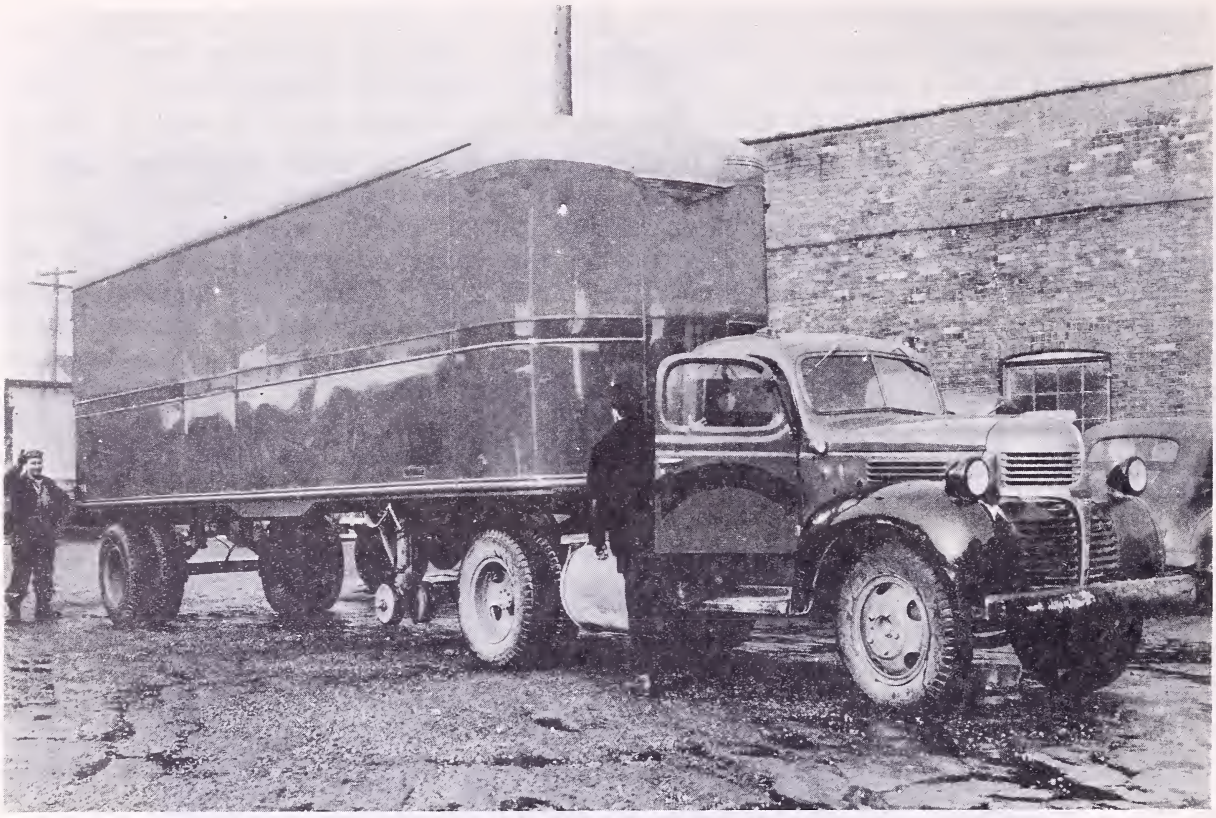

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Figure 2.--This large tractor-semitrailer combination employs both a driver and a helper. It hauls as much as 36,000 pounds of dry groceries.

The estimated load capacity for the tractor-semitrailers ranges from 18 to 12 tons of dry groceries; for the straight trucks, 9 to 6 tons (table 1).

Table 1.--Estimated maximum load capacity of dry groceries by type of vehicle

Type of truck	Number of trucks	Estimated maximum load capacity
		Tons
3-axle tractor-trailer combination	1	18
Do.	1	17½
Do.	3	12
Straight	1	9
Do.	4	7
Do.	1	6
Total	11	

SCOPE OF DELIVERY OPERATIONS

During the study 157.7 tons of dry groceries, valued at $35,931, were hauled on 19 different trips with an average weight per trip of 8.3 tons. On the basis of type of route the heaviest loads were hauled on the rural routes, and the lightest on the congested urban routes. The average weight per rural trip equaled 11.2 tons. For trips on combination routes (congested urban and other urban, and other urban and rural) the figure was 7.9 tons; for other urban, 5.5 tons; and for congested urban, 4.7 tons.

Total distance traveled for the 19 trips approximated 1,606 miles, or an average distance per trip of 85 miles. The rural runs are, of course, longer than the congested urban runs. Average distance traveled per rural trip was approximately 143 miles, while the average for the congested urban routes was only 16 miles. The distance for the combination trips (congested urban and other urban; other urban and rural) and other urban lay between these two distances. The average for the combination trips equaled about 65 miles, and for other urban, 38 miles.

Total delivery time for all trips in the study was 167 hours, while the average per trip approximated 9 hours. The average delivery time per trip by type of route was as follows:

Congested urban	5 hours, 52 minutes
Other urban	7 hours, 31 minutes
Rural	10 hours, 44 minutes
Combination	8 hours, 21 minutes

A total of 375 stops was made on the 19 trips, with an average per trip of approximately 20 stops. A total of 7,752 pieces was delivered on 369 orders, with the average per order approximating 21 pieces. 1/

TRIP-LOAD RATIO

The trip-load ratio for the 19 trips analyzed in the study ranged from 57 to 102 (table 2). This ratio is the relationship of load hauled to the estimated maximum truck capacity in hauling dry groceries; and the ratio of 102 does not mean that there was a violation of maximum-load limits prescribed by law. The capacity for each of the 3 types of motor vehicles was estimated by officials of the wholesale firm. Table 2 indicates that the capacity utilization for the straight trucks, both 1-man and 2-man operated,

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1/ The number of stops exceeds the number of orders because in a few cases the drivers had to make 2 stops per order, the second being for collection purposes.

Table 2.--Utilization of truck capacity in the delivery operations of an independent grocery wholesaler, 19 trips in selected periods, 1954

Trip No.	Type of vehicle	Type of operation	Estimated maximum capacity for dry groceries	Amount hauled	Trip-load ratio 1/
			Tons	Tons	Percent
1	Straight truck	1-man	7.0	4.0	57
2	do.	do.	7.0	4.5	64
3	do.	do.	7.0	5.0	71
4	do.	do.	7.0	5.0	71
5	do.	do.	7.0	5.5	79
6	do.	do.	7.0	5.5	79
7	do.	do.	7.0	5.5	79
8	do.	do.	7.0	6.0	86
9	do.	do.	6.0	6.1	102
10	do.	do.	7.0	6.5	93
11	do.	2-man	9.0	8.0	89
12	3-axle tractor-trailer combination--small	do.	12.0	10.8	90
13	3-axle tractor-trailer combination--small	do.	12.0	11.0	92
14	3-axle tractor-trailer combination--large	do.	18.0	11.0	61
15	3-axle tractor-trailer combination--large	do.	18.0	11.5	64
16	3-axle tractor-trailer combination--large	do.	17.5	11.5	66
17	3-axle tractor-trailer combination--large	do.	17.5	11.8	67
18	3-axle tractor-trailer combination-small	do.	12.0	12.0	100
19	3-axle tractor-trailer combination--large	do.	17.5	16.5	94

1/ Ratio of amount hauled to estimated maximum capacity.

and the smaller tractor-trailer combinations--12-ton capacity--was substantially above that for the large tractor-trailer combinations--17.5-18-ton capacity. In 9 of the 11 trips made with straight trucks, the trip-load ratio exceeded 70 percent. Of the 5 trips made with the large tractor-trailers, only 1 had a trip-load ratio of over 67 percent. In contrast, the 3 trips made with the smaller tractor-trailers had a trip-load ratio of 90 percent or better.

TRIP ROUTING

The planning and scheduling of routes for the Baltimore wholesale grocery firm are handled by 2 supervisors--one of whom is responsible for routing within Baltimore, the other for the area outside of Baltimore. Usually the drivers are not consulted about routing. Partly because of this factor, there is a need for improvement in the present routing operation as one means of reducing delivery costs.

For example, errors in routing were found in 11 of the 19 trips in the study. The number of errors ranged from 1 to 4 per trip. When orders are routed incorrectly it is very difficult if not impossible to rectify the mistake once the truck is loaded. In some cases the drivers discovered the errors while glancing over their trip tickets prior to arriving at the misrouted stops. If it were feasible to dig the order or orders out of the load, the drivers would make the change in the routing and deliver the orders in correct rotation. On some occasions the misrouted orders were too far back in the truck to permit the drivers to make the routing change. Backtracking ranging from a few city blocks to several miles resulted in these latter instances.

In addition to the extra expense, misrouting also creates ill will on the part of the customers because of the delay in delivery of their orders. Several instances of this type were observed during the period of study.

One example of misrouting is shown in figure 3. Although this appears to be a rather obvious error of misrouting, it is typical of errors found during the study. Two retailers were served in the sequence shown under "Previous Routing." This involved either running twice around the block to unload, as shown, or going straight north and hand-trucking the merchandise across a very busy street and over streetcar tracks--a still worse method, which was not actually used. With the routing changed as shown on the right, this extra driving or hazardous unloading is eliminated. The driver mentioned that he had pointed out to the dispatcher--who is responsible for the routing--the need for reversing the unloading order of these two stops. The dispatcher replied, "I can't see any advantage in it." However, when the author brought the problem to the attention of the firm's managers, the recommended routing was promptly adopted.

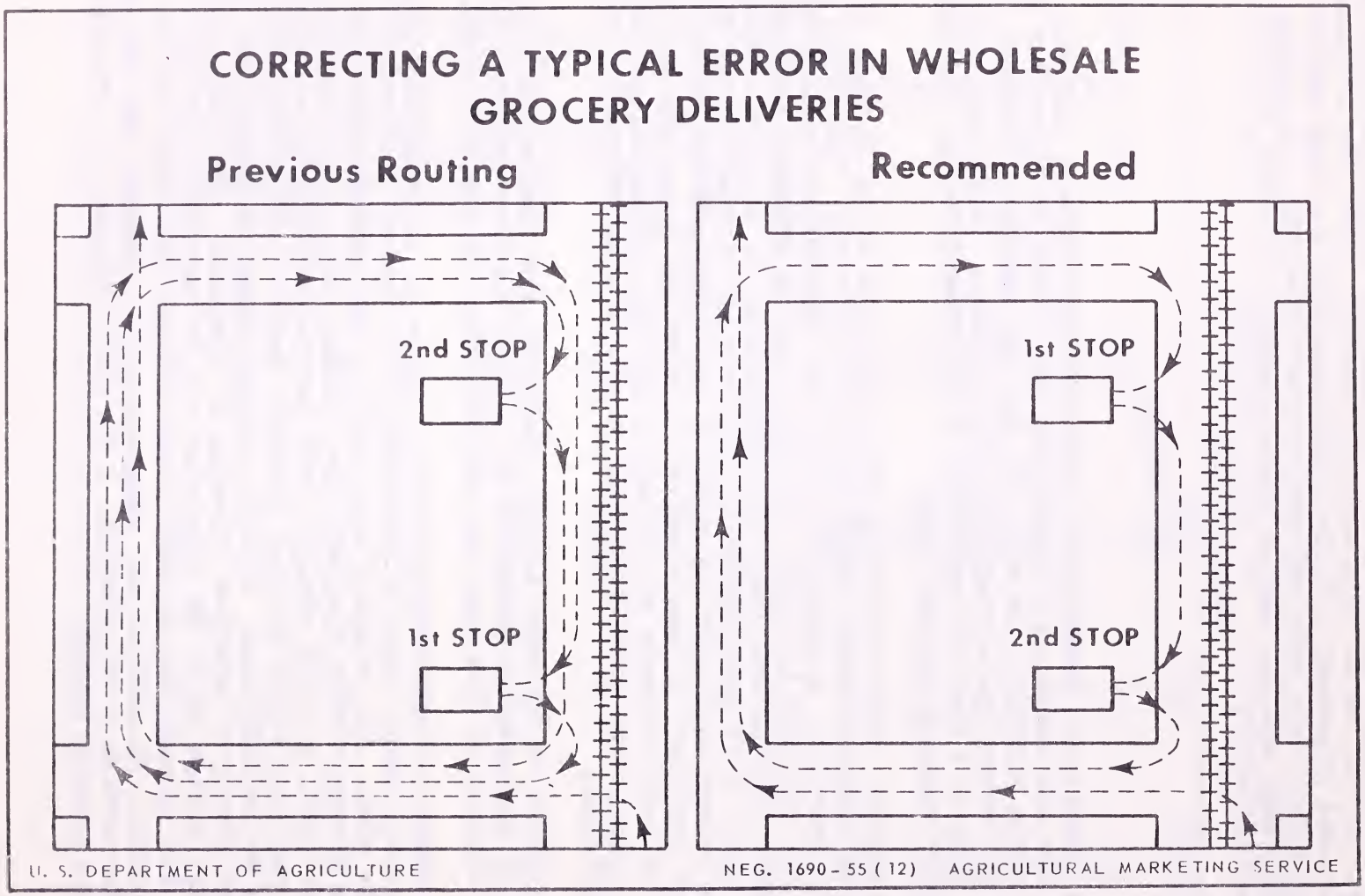
CORRECTING A TYPICAL ERROR IN WHOLESALE GROCERY DELIVERIES
Previous Routing
Recommended
2nd STOP
1st STOP
1st STOP
2nd STOP
U. S. DEPARTMENT OF AGRICULTURE
NEG. 1690-55 (12) AGRICULTURAL MARKETING SERVICE

Figure 3.

A somewhat different problem of routing, but one of equal importance, concerns the large amount of overtime accumulated by drivers and helpers on rural runs. For example, during the week of August 4-10, 1954 (a representative workweek), the 5 drivers and 3 helpers operating on predominately rural routes put in a total of 95¼ hours of overtime--an average of almost 12 hours per man. Under the terms of a Teamsters Union contract with the firm, the drivers and helpers are paid time and one-half for all work beyond 8 hours in any one day or 40 hours in any given week, and in addition are guaranteed a 43-hour workweek. This includes 40 hours at straight time and 3 hours at time and one-half. The amount of overtime for the above-mentioned drivers and helpers in the representative workweek exceeded the minimum guarantee by 71¼ hours. In contrast, the remaining 5 drivers and 1 helper put in a total of 17 3/4 hours of overtime--an amount which averaged one-quarter hour less than the minimum guarantee.

The amount of overtime hours put in by the drivers and helpers results in increased costs not only from the standpoint of the higher wage rate but also from lower productivity per worker due to fatigue. In 5 of the 8 rural trips, the delivery operations took more than 10 hours per trip. The longest trip was approximately 14 hours. The distances traveled ranged from 133 miles to 255 miles. At the same time, the average unloading operation for these 5 rural trips consisted of 11½ tons of groceries distributed at 28 stops.

DELIVERY OPERATIONS BY TYPE OF EQUIPMENT

Of the 19 trips studied, 11 were made by straight trucks and 8 by tractor-trailers. The straight trucks were used on all types of routes, including congested urban, other urban, rural, and combinations thereof; however, their primary use was on relatively short, close-in routes as typified by congested urban and other urban conditions. (Fig. 1.) The tractor-trailers, on the other hand, were employed exclusively on rural routes or combinations of "other urban" and rural routes. (Fig. 2.)

The distance traveled per trip for the straight trucks ranged from 13 to 87 miles, with an average per trip of 41 miles. In contrast, distance traveled per trip for the tractor-trailers ranged from 81 to 255 miles. The average distance traveled per trip for the tractor-trailers, 144 miles, is approximately 3½ times that traveled by the straight trucks (table 3). However, as a result of the less congested road conditions, the average driving time per trip for the tractor-trailers is only twice that for the straight trucks.

Because of the greater distances traveled, larger loads and greater number of stops, the average trip time for the tractor-trailers (driving time plus time for all other purposes) is substantially above that of the straight trucks. Whereas trip-time for the tractor-trailers ranged from 8 to approximately 14 hours, with the average near 11 hours, trip-time for the 11 trips made by straight trucks ranged from 5 to 10 hours, with an average of about 7 hours.

Table 3.--Delivery operations of an independent grocery wholesaler by type of equipment, selected periods, 1954

Item	Unit	Straight truck (average) 1/	3-axle tractor-trailer combination (average) 2/
Invoice value per trip	Dollars	1,371.50	2,605.52
Amount hauled per trip	Tons	5.6	12.0
Distance traveled per trip	Miles	41.0	144.4
Distance traveled per stop	Miles	2.3	6.3
Delivery time per trip	Minutes	442.3	643.9
Number of stops	Number	17.5	22.8
Time per trip to prepare truck for unloading	Minutes	4.5	7.0
Time per stop to prepare truck for unloading	Minutes	0.3	0.3
Unloading time per trip	Minutes	200.1	234.2
Unloading time per order	Minutes	11.8	10.3
Unloading time per piece	Minutes	0.7	0.4
Number of pieces unloaded per trip	Pieces	272.0	596.0
Number of pieces unloaded per order	Pieces	16.0	26.0
Distance hand-trucked or hand-carried per trip	Feet	704.5	800.0
Distance hand-trucked or hand-carried per order	Feet	43.0	35.0
Time per trip to close up truck	Minutes	4.6	7.5
Time per stop to close up truck	Minutes	0.3	0.3
Delivery time per order	Minutes	26.0	28.3
Delivery time per piece	Minutes	1.6	1.1
Driving time per trip	Minutes	170.9	342.0
Driving time per stop	Minutes	9.7	15.0
Delay time per trip	Minutes	37.6	27.2
Delay time per order	Minutes	2.2	1.2

1/ Average for 11 trips.
2/ Average for 8 trips.

The unloading operation for the two types of vehicles is similar. That is, the groceries are unloaded by hand and are then hand-trucked or hand-carried into the buyer's establishment. In a few instances, personnel of the buyer may assist in moving the merchandise from the tailgate of the vehicle into the store. Generally, however, they do not. A major difference in the unloading operation for tractor-trailers as compared with that of straight trucks is that, with the former, a helper accompanies the driver and assists in the unloading. With one exception--previously mentioned--the straight trucks are 1-man operations.

The unloading time shown in table 3 consists in the time spent in breaking down the orders in the truck--including placing the merchandise on the tailgate; moving the merchandise from the tailgate into the buyer's establishment; checking the merchandise inside the buyer's establishment; collecting--if a c.o.d. order; and returning to the truck. The time required to open and close the doors of the truck was excluded from the unloading operation. Similarly the actual time spent at lunch was deducted from the unloading time. The firm authorizes 30 minutes for this purpose, and deducts this amount from the individual time cards. In some cases the men took less than 30 minutes; in other cases, a few minutes more.

Delay time at several of the stops was also excluded from the unloading time. Delay time at the stop may arise from (1) waiting for other vehicles to move away from the customer's unloading platform, (2) waiting for the storekeeper to open the store, and (3) purchasing cigarettes or drinking "cokes." However, the time spent in this last manner was a small proportion of the total delay time.

As shown by table 3, average unloading time per trip for the tractor-trailers exceeds that for the straight trucks by approximately 17 percent. At the same time, the average amount hauled by the tractor-trailers was about twice that for the straight trucks. The shorter distance required to hand-truck or hand-carry the orders delivered by tractor-trailer tended to make for a faster unloading time. Table 3 does not indicate that either method of delivery--straight truck or tractor-trailer--has a definite superiority over the other.

DELIVERY OPERATIONS: 1-MAN AND 2-MAN

The 1-man and 2-man deliveries represent straight truck and tractor-trailer operations, respectively, with the exception of the previously mentioned straight truck on which 2 men are used. The data in table 4 are thus fairly comparable to those in table 3.

The ratio of work accomplished on a per man basis by the 2 different types of operation appears to favor the 2-man operation. Somewhat more than twice the tonnage, as well as number of pieces, was delivered on the average 2-man trip as compared with the 1-man operation. At the same time the

Table 4.--One-man and two-man delivery operations of an independent grocery wholesaler, selected periods, 1954

Item	Unit	One-man delivery operation (average) 1/	Two-man delivery operation (average) 2/
Invoice value per trip	Dollars	1,313.42	2,532.94
Amount hauled per trip	Tons	5.4	11.6
Distance traveled per trip	Miles	41.4	132.4
Distance traveled per stop	Miles	2.5	5.8
Delivery time per trip	Minutes	437.4	626.9
Times per trip to prepare truck for unloading	Minutes	4.3	7.1
Time per stop to prepare truck for unloading	Minutes	.3	.3
Number of stops per trip	Stops	17.0	22.8
Unloading time per trip	Minutes	191.9	239.4
Unloading time per order	Minutes	11.8	10.5
Unloading time per piece	Minutes	.7	.4
Number unloaded per trip	Pieces	255.0	578.0
Number unloaded per order	Pieces	16.0	25.0
Distance hand-trucked or hand-carried per trip	Feet	660.4	838.3
Distance hand-trucked or hand-carried per order	Feet	42.1	36.6
Time per trip to close up truck	Minutes	4.2	7.7
Time per stop to close up truck	Minutes	.3	.3
Delivery time per order	Minutes	26.8	27.4
Delivery time per piece	Minutes	1.7	1.1
Driving time per trip	Minutes	173.0	320.6
Driving time per stop	Minutes	10.2	14.1
Delay time per trip	Minutes	40.5	25.2
Delay time per stop	Minutes	2.5	1.1

1/ Average for 10 trips.
2/ Average for 9 trips.

average delivery period for the 2-man operation exceeded the 1-man operation by only 43 percent. Average distance traveled per trip for the 2-man delivery was more than 3 times as great as for the 1-man delivery, while the average distance traveled per stop for the former was approximately 2½ times the latter.

It should be noted, however, that route conditions in this study tend to favor the 2-man delivery operation. Data for this operation come primarily from rural hauls, while the 1-man operation is largely congested urban and other urban hauls. In addition, the average distance hand-trucked or hand-carried per order was less for the 2-man delivery operation.

The 2-man unloading operation varies somewhat among the driver and helper teams. Generally the driver breaks the order down in the truck, while the helper hand-carries or hand-trucks the merchandise into the buyer's establishment. In some cases, however, this procedure is reversed. Typically when breaking down the orders in the truck, with either the 1-man or 2-man unloading operation, each order is checked off the invoice, item by item. This same procedure is then followed in the buyer's establishment. The delivery personnel mentioned that this duplicate checking procedure was necessary because of the frequency of errors in order filling. Drivers reported they had encountered 3 to 4 errors each week.

In addition, although the order-filling personnel is supposed to place an order number on each item corresponding to the sequence in which the orders are to be unloaded, most of the less-than-case-lots originating from the broken-package room do not have any numbers. The difficulties which the driver encounters in determining the ownership of these unnumbered pieces are manifest. Then, too, many of these small unnumbered pieces are tossed up on top of the load by the loading personnel. Oftentimes they slide down behind the rows of merchandise and are not found until after the particular orders to which they belong have been unloaded.

In several instances two different numbers were found on the same case. This situation apparently arose through failure of the warehouse personnel to delete the order numbers from cases of merchandise which had been sent out on previous orders and then returned.

DELIVERY OPERATIONS BY TYPE OF ROUTE

The Baltimore wholesale grocery firm delivers 2 to 3 times as much tonnage per rural route as it does per congested urban or other urban route. (Table 5.) Because of the larger loads, greater distances, and more numerous stops, delivery time per trip increases substantially for other urban, rural, and combination routes, as compared with congested urban routes. But on a per order or per piece basis, delivery time for the rural and combination routes is comparable to that for the congested urban and other urban routes. In fact, delivery time per piece for the rural and combination routes is less than for the congested urban and other urban routes.

The primary reason for this better delivery time per piece for rural and combination routes is that the orders run considerably larger on these routes than on the congested urban and "other urban." Whereas the average size order for these latter routes was only 15 and 13 pieces respectively, an average of 25 and 23 pieces per order was delivered on the rural and combination routes. The type of truck-trailer combination used for deliveries on rural routes is shown in figure 4.

Because a common series of operations must be performed in delivering each order irrespective of size, the time required to deliver a 30-piece order is not double that for 15 pieces. This fact is further illustrated by

Table 5.--Delivery operations of an independent grocery wholesaler by type of route, selected periods, 1954

Item	Unit	Congested urban 1/	Other urban 2/	Rural 3/	Combination 4/
		Average	Average	Average	Average
Invoice value per trip	Dollars	1,167.15	1,286.86	2,437.46	1,945.55
Amount hauled per trip	Tons	4.7	5.5	11.2	7.9
Distance traveled per trip	Miles	15.5	38.0	143.1	65.5
Distance traveled per stop	Miles	1.0	1.9	6.4	3.7
Delivery time per trip	Minutes	352.3	451.0	643.8	501.0
Number of stops	Stops	15.0	20.0	22.4	17.8
Unloading time per trip	Minutes	157.4	184.6	238.0	240.0
Unloading time per order	Minutes	11.2	9.7	10.6	13.5
Unloading time per piece	Minutes	.7	.8	.4	.6
Number of pieces unloaded per trip	Pieces	216.0	245.0	564.0	403.0
Number of pieces unloaded per order	Pieces	15.0	13.0	25.0	23.0
Distance hand-trucked or hand-carried per trip	Feet	764.7	578.0	815.2	754.8
Distance hand-trucked or hand-carried per order	Feet	63.7	30.4	36.2	42.5
Delivery time per order	Minutes	25.2	23.7	28.6	28.2
Delivery time per piece	Minutes	1.6	1.8	1.1	1.2
Driving time per trip	Minutes	103.1	187.8	346.1	196.5
Driving time per stop	Minutes	6.9	9.4	15.5	11.1
Delay time per trip	Minutes	58.5	50.5	20.6	20.1
Delay time per stop	Minutes	4.2	2.7	.9	1.1

1/ Average for 3 trips.
2/ Average for 4 trips.
3/ Average for 8 trips.
4/ Average for 1 congested urban and other urban and 3 other urban and rural trips.

the unloading time per piece for the various orders. For example, the unloading time per piece for rural orders is half that for "other urban." At the same time the average rural order is approximately twice the size of the average "other urban" order.

In comparing the unloading times per order, the distance required to hand-truck or hand-carry the orders has a substantial influence upon this time. For example, "other urban" orders, which had the shortest unloading time per order (9.7 minutes), were hand-trucked or hand-carried the shortest distance--30.4 feet. (This is the one-way distance only; that is, from the truck into the buyer's establishment.) In contrast, congested urban orders were hand-trucked or hand-carried about 64 feet and were unloaded in 11.2 minutes.

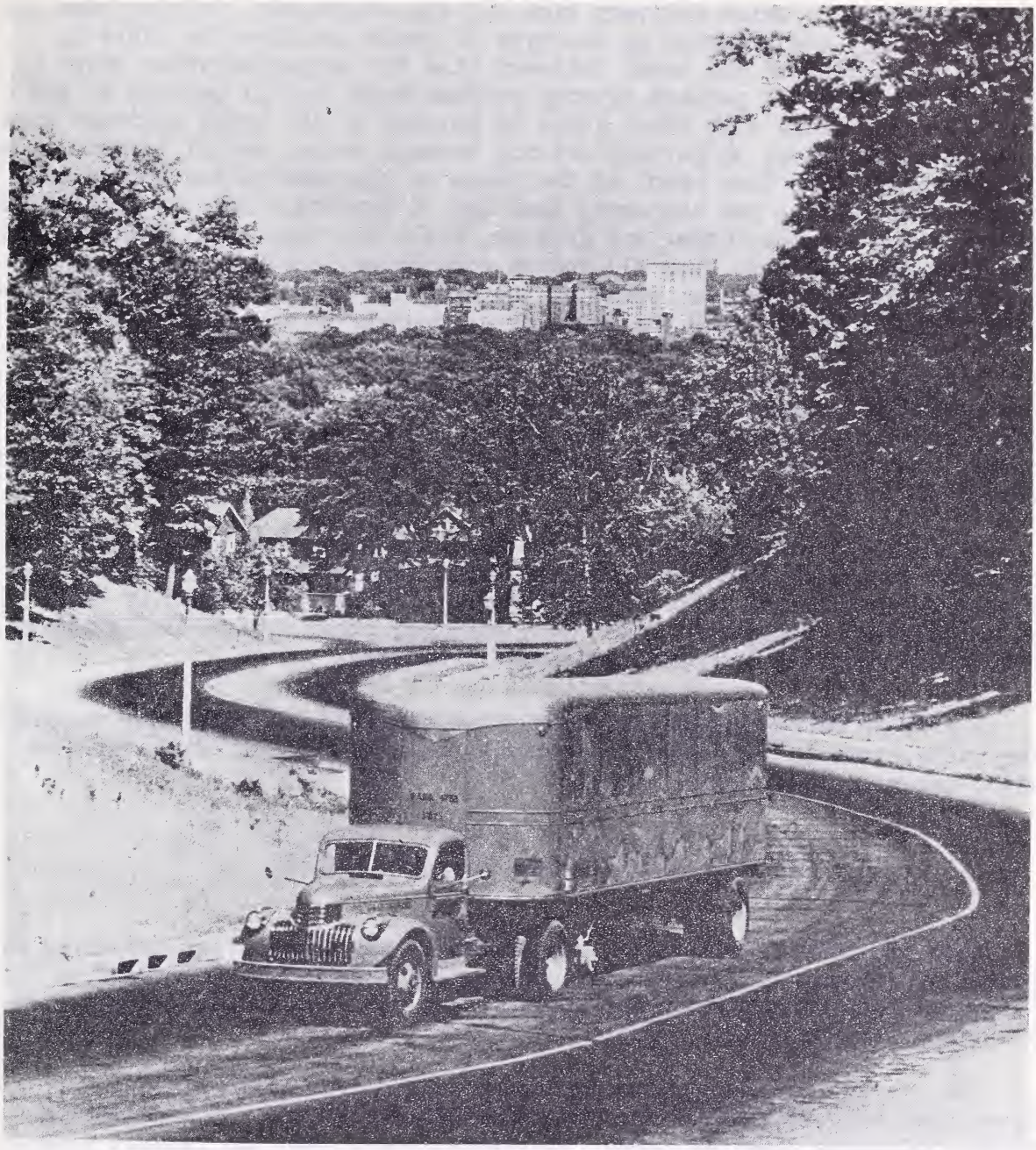

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Figure 4.--A large tractor-semitrailer combination owned by a wholesale grocer moves out of the city in the early morning hours to make deliveries to retailers in rural areas.

The extent to which delivery time and its components, driving time and unloading time, are affected by the type of route are shown in table 6. Whereas 65 percent of the total delivery time for congested urban stops is spent at the stop, 24 percent driving between stops, and 11 percent to and from the route area, with rural stops 45 percent of the total delivery time is spent at the stop, 34 percent driving between stops, and 21 percent to and from the area. The time spent at the stops on the combination routes and "other urban" routes was the same; that is, 56 percent. But the driving time between stops for the former was greater, while the time spent going to and from the area was less. For all routes considered together, 51 percent of the total delivery time was spent at the stop and 49 percent in driving between stops or to and from the route area--roughly an equal division.

The large percentage of driving time required for the several routes substantially increases delivery costs--especially where 2 men per truck are used. As pointed out earlier, this latter operation is typical for rural routes. At the same time it is the rural routes which have the highest percentage of driving time.

A partially offsetting factor to this high percentage of driving time for rural routes is that there is less delay time at the rural stops. The average delay time per trip for the 4 types of routes, as shown by table 5, was as follows: Congested urban--58.5 minutes; other urban--50.5 minutes; rural--20.6 minutes; and combination--20.1 minutes.

A greater percentage of the total time spent at the rural and combination route stops is thus used productively than is true of either the congested urban or other urban stops.

DELIVERY OPERATIONS BY TYPE OF CUSTOMER

Approximately 71 percent of the orders in the sample were delivered to stores, 17 percent to hotels, restaurants, and cafeterias, 7 percent to institutions such as hospitals and schools, and the remaining 5 percent were to a miscellaneous group. (Table 7.)

The average unloading time per order ranged from 11.76 minutes for stores down to 8.23 minutes for the miscellaneous group. In considering average unloading time per piece, the store orders have the fastest time--0.48 minutes, the hotel and restaurant group the slowest--0.74 minutes. However, the average number of pieces per store order is approximately twice that of the other types of orders.

Average unloading time per dollar of sales is likewise the least for the store orders--approximately 0.11 minutes. The miscellaneous group had the greatest unloading time per dollar of sales--approximately 0.14 minutes,

Table 6.--Variations in total unloading time and total driving time by type of route, selected periods, 1954

Item	Total time at stops	Percentage of total delivery time	Total driving time				Total delivery time by type of route	
			Between stops	Percentage of total delivery time	To and from route area	Percentage of total delivery time		
	Minutes	Percent	Minutes	Percent	Minutes	Percent	Minutes	Percent
Congested urban	685	65	256	24	116	11	1,057	100
Other urban	1,006	56	554	31	244	13	1,804	100
Rural	2,303	45	1,764	34	1,083	21	5,150	100
Combination: (1) Congested and other urban	307	63	163	33	21	4	491	100
Combination: (2) Other urban and rural	815	54	586	39	113	7	1,514	100
Total combination 1/	1,122	56	749	37	134	7	2,005	100
Total all routes	5,116	51	3,323	33	1,577	16	10,016	100

1/ Consists of 1 congested urban and other urban, and 3 other urban and rural routes.

Table 7.--Total and average unloading time by type of customer, selected periods, 1954

Type of customer	Number of orders	Total unloading time	Average unloading time per order	Average number of pieces per order	Average unloading time per piece	Total sales	Average unloading time per dollar of sales
	Number	Minutes	Minutes	Number	Minutes	Dollars	Minutes
Institutions (hospitals, schools, etc.)	27	261.82	9.70	13.26	0.73	2,140.26	0.12
Hotels, restaurants, cafeterias, etc.	62	583.71	9.41	12.74	.74	4,451.16	.13
Stores	262	3,080.22	11.76	24.33	.48	28,256.03	.11
Other	18	148.18	8.23	12.72	.65	1,083.25	.14
Total or average	369	4,073.93	11.04	21.01	0.53	35,930.70	0.11

while the average unloading time for all types of customers equalled that of the stores--0.11 minutes. The reason for this statistical oddity lay in the fact that stores accounted for 79 percent of the total sales; and the range in unloading time was quite narrow, among the types of customers.

As pointed out earlier, variations in the unloading time per order for the several types of customers are caused not only by differences in order size, but also by differences in the hand-trucking or hand-carrying distance for the various orders. For example, institutional orders are hand-trucked or hand-carried an average distance of 90 feet. (Table 8.) In contrast, store orders are moved from the truck into the store an average distance of only 28 feet. Hotel and restaurant orders are hand-trucked or hand-carried approximately 58 feet and the miscellaneous group orders about 65 feet. The average for all types equaled 39 feet.

Another factor which has some influence upon the unloading time for institutional, hotel, and restaurant orders, is that these orders often include several heavy items such as large sacks of flour, sugar, salt, beans, peas, etc. When these items are to be resold by stores, the containers are smaller.

Table 8.--Distance groceries were hand-trucked or hand-carried, by type of customer, selected periods, 1954

Type of customer	Number of orders	Total distance hand-trucked or hand-carried 1/	Average distance hand-trucked or hand-carried 1/
	Number	Feet	Feet
Institutions (hospitals, schools, etc.)	27	2,433	90
Hotels, restaurants, cafeterias, etc.	58	3,311	58
Stores	262	7,308	28
Other	16	1,097	65
Total or average, all types 2/	363	14,149	39

1/ Includes the 1-way distance only; that is, the distance from the truck into the buyer's establishment.

2/ No estimates made of distance hand-trucked or hand-carried on first 6 orders of trip number 1.

DELIVERY OPERATIONS FOR C.O.D. AND CHARGE ORDERS

Of the 369 orders delivered on the trips studied, 224, or 61 percent, were charge orders and the remaining 145 orders, 39 percent, were c.o.d. (Table 9.)

In two types of routes, other urban and the combination routes, the number of c.o.d. orders exceeded the charge orders. However, in the case of congested urban and rural routes, the number of c.o.d. orders was substantially less than the number of charge orders.

The distribution of c.o.d. and charge orders among types of customers reveals that almost one-half of the 262 store orders were c.o.d. In contrast, deliveries to institutions, such as hospitals, schools, and churches, and to hotels and restaurants are largely made on a charge basis. The number of c.o.d. and charge orders by type of customer was as follows: Institutions--1 c.o.d., 26 charge; hotels--16 c.o.d., 46 charge; stores--126 c.o.d., 136 charge; and other--2 c.o.d., 16 charge.

As might be expected, the time spent in collecting c.o.d. orders shows up rather strongly in comparing the overall unloading times on a piece basis for the 2 types of orders. For example, the average unloading time per c.o.d. order is 10.52 minutes, while it is 11.38 minutes per charge order. But an average of 24.6 pieces was unloaded for the charge orders at the rate of 0.46 minutes per piece. In contrast, the average c.o.d. order contained only 15.5 pieces, and had an average unloading time of 0.68 minutes per piece.

Table 9.--Number and percent of c.o.d. vs. charge orders, by type of route, selected periods, 1954

Type of route	C.o.d. orders: Number	C.o.d. orders: Percentage of total: Percent	Charge orders: Number	Charge orders: Percentage of total: Percent	Total orders: Number	Total orders: Percentage of total: Percent
Congested urban	10	24	32	76	42	100
Other urban	40	53	36	47	76	100
Rural	55	31	125	69	180	100
Combination	40	56	31	44	71	100
Total, all types	145	39	224	61	369	100

The impact which the time spent in collecting has upon the unloading operations is demonstrated even more clearly if, in analyzing the unloading times for c.o.d. and charge orders, we distinguish between 1-man and 2-man operations (table 10).

Table 10.--Unloading times for 1-man and 2-man operations, c.o.d. and charge orders, selected periods, 1954

Item	Unit	1-man		2-man	
		C.o.d.	Charge	C.o.d.	Charge
Average unloading time per order	Minutes	11.49	11.99	9.61	10.94
Number of pieces unloaded	Pieces	14.00	17.00	17.00	30.00
Average unloading time per piece	Minutes	.83	.70	.56	.37
Differential between unloading time per piece: c.o.d. and charge	Minutes	.13		.19	

The differential between the unloading times per piece for c.o.d. and charge orders with a 2-man operation is only half again as great as with 1 man. This fact was borne out by the writer's observation that while one of the men was collecting, the other man spent a large part of this time in idleness. In some cases as much as half the total time at the stop was for collection purposes.

The time spent in collecting c.o.d. orders affects not only the unloading time but also the driving time. For example, the following event took place on two different occasions during the period of study. The driver on one of the rural routes drove up to his second scheduled stop at 9:05 a.m., found the store still closed and, proceeding in what he termed the standard method for servicing this type of customer, left the merchandise on the front porch. However, since this was a c.o.d. order ($23 value), it was necessary for the driver to make a second stop at the store to collect. This second stop, which was made on the return trip, involved driving an additional 10 to 12 miles. In addition, the route back to the city via the locality of the second stop was much more congested than the route the driver would ordinarily use if no backtracking were necessary. Because of the extra distance and more congested route, approximately 1 hour of additional time was required to make this second stop. The additional stop cost the wholesaler $6.08. This amount is limited to the nonlabor variable expenses of the particular truck, and the labor expenses of the driver and helper. The unprofitability of incurring collection costs of $6.08 on a $23 order is obvious.

The alternative to collecting in the above way would be to allow the customer to charge the order--a procedure which also might lead to heavy collection costs, of course. In any event, a collection cost equaling one-fourth of the value of the order is a strong argument for the wholesaler's refusing hereafter to accept orders below a specified minimum value.

UNLOADING TIME BY VALUE OF ORDER AND LOCATION OF BUYER

The relationship of order size to unloading time is demonstrated in table 11. For example, the average unloading time per piece for orders under $25 is nearly three times that for large orders of $300 and over. Likewise, the average unloading time per dollar of sales for the smallest size orders--under $25--also exceeded that for the largest category--$300 and over--by an approximate ratio of 3 to 1.

The average unloading time per piece and per dollar of sales declines with a high degree of consistency as order size increases. The lengthy unloading time for the small size "other urban" orders is due to the fact that this particular grouping is composed almost entirely of institutional and restaurant orders, which require a great deal of service even though the orders are small.

In analyzing the unloading times by location of buyer, the difficulties of making deliveries in relatively congested areas are clearly indicated in table 11. In nearly all categories, average unloading time per order, piece, or dollar of sales is less in "other urban" and rural localities than in congested urban areas. The differential in unloading time tends to be greater between the rural and "other urban" groups than between the latter and congested urban.

Difficulties in unloading in congested urban areas are illustrated by the following event which took place during the study.

A large restaurant, which regularly receives a sizable order, would not permit the driver to unload because he arrived at 12:20 p.m. Apparently this firm will not receive merchandise between the hours of 12 noon and 2 p.m. The driver waited 15 minutes for the restaurant manager, who then came out and told the driver he would have to come back after 2 p.m. to deliver the merchandise. On the return call later on in the afternoon, the driver was delayed 55 minutes by traffic in the alley. For a time, it was not possible to move either forward or backward in the alley.

When comparing unloading times per piece for the several groups of orders, the greatest decrease is shown between the first 2 groups and between the last 2 groups (table 11). Between the group under $25 and the $25-$74.99 group, the unloading time per piece declines from 0.90 to 0.68 minutes--a drop of 24 percent. Between the $150-$299.99 group and the top group, $300 and over, the unloading time per piece declines 29 percent, from 0.48 to 0.34 minutes. In contrast, the decrease between the second and third and between the third and fourth groups was 15 and 17 percent respectively.

Table 11.--Total and average unloading time by value of order and location of buyer, selected periods, 1954

Value of order and location of buyer	No. of orders	Unloading time	Average unloading time--		
			Per order	Per piece	Per dollar of sales
		Minutes	Minutes	Minutes	Minutes
Under $25					
Congested urban	12	44.27	3.69	0.85	0.24
Other urban	9	45.91	5.10	1.24	.29
Rural	19	63.40	3.34	.78	.23
Total or average	40	153.58	3.84	.90	.25
$25 - $74.99					
Congested urban	34	296.06	8.71	.88	.19
Other urban	55	469.86	8.54	.80	.18
Rural	88	587.37	6.67	.55	.14
Total or average	177	1,353.29	7.65	.68	.16
$75 - $149.99					
Congested urban	15	218.34	14.56	.79	.14
Other urban	30	355.28	11.84	.63	.12
Rural	49	483.23	9.86	.49	.10
Total or average	94	1,056.85	11.24	.58	.11
$150 - $299.99					
Congested urban	10	230.24	23.02	.61	.12
Other urban	7	151.73	21.68	.52	.11
Rural	26	435.61	16.75	.42	.08
Total or average	43	817.58	19.01	.48	.09
$300 and over 1/					
Congested urban	1	27.84	27.84	.44	.08
Other urban	2	66.77	33.38	.43	.08
Rural	12	597.69	49.81	.33	.08
Total or average	15	692.30	46.15	.34	.08
Grand total or average	369	4,073.60	11.04	0.53	0.11

1/ Further breakdown in value of the order was prevented by the small number appearing in the class interval.

NONLABOR EXPENSES OF THE WHOLESALER'S DELIVERY TRUCKS

The data in table 11 provide valuable insight into the effects of variations in order size and location of buyer upon the average unloading time of the several groups of orders. But to make this information more worthwhile to the wholesaler, it is necessary to convert these unloading times as well as the balance of the delivery time--including driving time--to a dollars and cents basis. As was previously pointed out, the driving time on rural routes exceeds the total time at the stops. Even on congested urban routes, driving time accounts for more than a third of the total delivery time. As a means of evaluating the overall delivery operation, this section of the report has utilized cost analysis for determining the labor and nonlabor delivery expenses by individual vehicle, by order, per mile, and per dollar of sales.

Gasoline and Oil

Except as noted below, the period for which data were obtained regarding the nonlabor expense incurred by the wholesale firm in the operation of its delivery trucks was December 1, 1953, through November 30, 1954. During that time, gasoline and oil was the second largest nonlabor expense item. It was exceeded only by the depreciation expense.

The amount of gasoline consumed is associated with the miles traveled. In addition, other factors, such as the size of the vehicle, its age, road conditions, and number of stops are associated with gasoline consumption. For example, the lower gasoline mileage for the tractor-semitrailer combinations--5.2 miles per gallon as compared to 7.0 miles per gallon for the straight trucks--reflects the difference in size of the 2 types of vehicles. (Table 12.)

The larger, more powerful motors in the truck-tractors make for greater consumption of gasoline. At the same time the heavily congested areas in which the straight trucks (with the exception of truck No. 16) typically travel serves to keep the gasoline mileage of these vehicles at a relatively low level. This fact is illustrated in table 12, in that 3 of the 6 straight trucks fall within the gasoline mileage range of the tractor-semitrailers.

The relatively high mileage per gallon of gasoline for the No. 16 straight truck is due to the fact that this vehicle is used to a considerable extent on rural or a combination of "other urban" and rural routes. Traffic congestion is less on these routes than on congested urban or other urban routes.

The average gasoline mileage of 5.8 miles per gallon compares very favorably with that of the U. S. Government Fleet Operation for the year ended June 30, 1954. During this period, U. S. Government trucks--excluding military vehicles--with gross weights of 17,000 to 24,499 pounds, and

Table 12.--Gasoline and oil expense of wholesaler's delivery trucks, December 1, 1953-November 30, 1954

Item	Year of manufacture	Amount of gasoline used	Distance traveled	Distance per gallon	Gasoline expense	Amount of oil used	Oil expense	Total gasoline and oil expense	Gasoline and oil expense per vehicle mile
		Gallons	Miles	Miles	Dollars	Quarts	Dollars	Dollars	Dollars
Straight truck:									
Number 10.	1948	850.7	4,520	5.3	199.06	72	14.04	213.10	0.0471
Number 11.	1954	1,215.5	8,038	6.6	284.43	127	24.77	309.20	.0385
Number 12.	1950	1,405.8	8,520	6.1	328.96	72	14.04	343.00	.0403
Number 16.	1952	1,636.5	17,308	10.6	382.94	145	28.28	411.22	.0238
Number 17.	1948	1,208.1	6,004	5.0	282.70	41	8.00	290.70	.0484
Number 20.	1950	1,980.6	13,940	7.0	463.46	113	22.04	485.50	.0348
Total or average . .		8,297.2	58,330	7.0	1,941.55	570	111.17	2,052.72	.0352
3-axle tractor semi-trailer combination:									
Number 14.	1950	3,893.6	19,694	5.1	911.10	163	31.78	942.88	.0479
Number 24.	1951	4,611.8	21,632	4.7	1,079.16	181	35.30	1,114.46	.0515
Number 25.	1951	1,542.2	9,743	6.3	360.87	72	14.04	374.91	.0385
Number 26.	1953	2,919.6	13,070	4.5	683.19	127	24.77	707.96	.0542
Number 28.	1953	4,222.7	24,513	5.8	988.11	199	38.80	1,026.91	.0419
Total or average . .		17,189.9	88,652	5.2	4,022.43	742	144.69	4,167.12	.0470
Grand total or average.		25,487.1	146,982	5.8	5,963.98	1,312	255.86	6,219.84	.0423

24,500 pounds and over (the gross weight categories of the wholesaler's delivery trucks) averaged 4.7 and 3.4 miles respectively per gallon of fuel. 2/

Like gasoline, oil consumption is also associated with the miles traveled. But condition of the motor is of even greater importance. When compared with the gasoline expense, however, oil expense of the fleet is quite insignificant. It amounts to only 4 percent of the total gasoline and oil expense.

The average gasoline and oil expense per mile for the tractor-trailers of $0.0470 exceeds that of the straight trucks ($0.0352) by approximately 34 percent, despite the more favorable traffic conditions under which the former operate (table 12). The gasoline and oil expense, for all of the vehicles considered together, averaged slightly over 4 cents per mile. Both gasoline and oil are purchased by the firm in quantity lots at a price somewhat below that of the retail level.

Tires

Total tire expense for the 12-month period ending November 30, 1954, equaled approximately $2,345. (Table 13.) Of this amount $946, or 40 percent, represented the tire expense for the straight trucks, and $1,398, or 60 percent, the tire expense for the 3-axle tractor-semitrailer combinations.

Since the firm does not maintain individual tire records, tire expense for a 22-month period, 3/ was used so as to reduce the effects of either unusually large or unusually small purchases of tires or repairs such as might occur over a single 12-month period. Tire expense for the 12-month period ended November 30, 1954, was estimated by computing 12/22 of the amount for the entire 22-month period.

During the 22-month period, 34 new tires or retreads were placed on the 6 straight trucks. At this rate, a complete turnover of new tires or retreads for the straight trucks would take place approximately every 2 years. In contrast, the rate of turnover of tires for the tractor-semitrailers approximates 3 years on the basis of purchasing 39 new tires and retreads during the 22-month period. Because of diversity in road conditions on the several routes, in the skill of the drivers, and in other factors which affect tire wear, purchases of new tires or retreads occur at irregular intervals. The firm does not maintain individual tire records to guide it in its tire replacement program. Such detailed record-keeping would undoubtedly prove

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2/ U. S. General Services Administration, Federal Supply Service, Annual Motor Vehicle Report, for the Fiscal Year Ending June 30, 1954, December 1954.

3/ For all vehicles--with the exception of number 11--tire expense data were obtained for 22 months (Jan. 1-April 30, 1953, and June 1, 1953-Nov. 30, 1954). The data for truck number 11--a new vehicle--cover the 11-month period (Jan. 1, 1954-Nov. 30, 1954).

Table 13.--Tire expense of wholesaler's delivery trucks, January 1, 1953 - November 30, 1954

Item	Year of manufacture	Expense for 12 months 1/	Distance traveled: 12 months ending November 30, 1954	Expense per vehicle-mile
		Dollars	Miles	Dollars
Straight truck				
Number 10	1948	110.02	4,520	0.0243
Number 11 2/	1954	75.19	8,038	.0094
Number 12	1950	142.94	8,520	.0168
Number 16	1952	211.48	17,308	.0122
Number 17	1948	198.36	6,004	.0330
Number 20	1950	208.90	13,940	.0150
Total or average	-	946.89	58,330	0.0162
3-axle tractor-semi-trailer combination				
Number 14 3/	1950	270.31	19,694	0.0137
Number 24 3/	1951	306.37	21,632	.0142
Number 25 4/	1951	164.21	9,743	.0169
Number 26 4/	1953	249.88	13,070	.0191
Number 28 3/	1953	407.91	24,513	.0166
Total or average	-	1,398.68	88,652	0.0158
Grand total or average		2,345.57	146,982	0.0160

1/ Except for vehicle 11, tire expense data were obtained for 22 months (Jan. 1 - April 30, 1953, and June 1, 1953 - Nov. 30, 1954). This column shows 12/22 of tire expense for the 22 months.

2/ New vehicle. Data cover Jan. 1, 1954 - Nov. 30, 1954 only.

3/ Consists of 1 tractor and 2 trailers. The trailers are operated on alternate days.

4/ Consists of 1 tractor and 1 semitrailer. In addition, the tire expense for an extra semitrailer was apportioned to tractors No. 25 and No. 26, on the basis of mileage traveled.

costly for firms other than those operating large fleets of trucks. In lieu of individual tire records, the Baltimore wholesaler has a contract with one of the tire companies which provides for a tire check and servicing of all vehicles at regular weekly intervals. The benefits of this program are reflected in the favorable tire expense per mile.

As shown by table 13, the average cost per vehicle-mile for the straight trucks and tractor-semitrailers is comparable; approximately 1.62 cents for the former, and 1.58 cents for the latter.

But the variation in tire expense per vehicle-mile is greatest among the straight trucks. Here it ranges from 0.9 cents to 3.3 cents per mile, while the tractor-trailers' tire expense ranges from 1.4 cents per mile to 1.9 cents per mile. The larger disparity in tire expense for the straight trucks may be explained in this way:

(1) The No. 11 vehicle was purchased new in the early part of 1954, and thus its tire expense for that year would, of course, be low and,

(2) The rather high tire expense per mile for trucks 10 and 17 conceivably reflects differences in driver skill and also some comparatively constant cost factors which are not related to miles traveled--for example, deterioration of tires from age, curb damage to side walls, and wear from stop-and-go operations. An average of 5.8 tires, including new tires and retreads, was purchased for each straight truck during the 22-month period. The number of such purchases for trucks 10 and 17 was 4 and 6 tires respectively. The replacement of tires for these 2 vehicles is thus near the average of all the straight trucks, despite the low mileage traveled by No. 10 and No. 17.

Repairs and Parts

The amount of repairs needed for a motor vehicle during a given year depends mainly on its condition at the beginning of the year and the number of miles it travels during the year. However, other factors, such as the skill of the driver, the condition of the roads, and the frequency of stop-and-go, also have some influence upon the amount of repairs. To the extent that age affects motor and body condition, repairs increase as the vehicle becomes older. In table 14, the trucks with the greatest repair expense are in most cases the oldest.

The average repairs and parts expense per mile for the tractor-trailers is slightly less than that for the straight trucks despite the fact that the mileage traveled by the former was considerably greater than for the latter. The higher expense for the straight trucks is undoubtedly due to the fact that the average age of these vehicles is nearly 4 years, while the average age of the tractor-trailers is approximately 2½ years.

The high repairs and parts expense per vehicle-mile for straight trucks 17, 10, and 12, and tractor-trailers 25 and 14 suggest that a close watch be kept of further repairs on these vehicles. Continued expenditures at this level may indicate the necessity for their replacement. 4/

4/ Soon after the completion of the field work on this study, truck number 10 was replaced by a new straight truck.

Table 14.--Repairs and parts expense of wholesaler's delivery trucks, December 1, 1953 - November 30, 1954

Item	Year of manufacture	Distance traveled	Expense per vehicle	Expense per vehicle-mile
		Miles	Dollars	Dollars
Straight truck				
Number 10	1948	4,520	200.17	0.0442
Number 11	1954	8,038	109.16	.0136
Number 12	1950	8,520	296.92	.0348
Number 16	1952	17,308	207.41	.0120
Number 17	1948	6,004	478.58	.0797
Number 20	1950	13,940	365.84	.0262
Total or average	-	58,330	1,658.08	0.0284
3-axle tractor-semitrailer combination				
Number 14	1950	19,694	715.55	0.0363
Number 24	1951	21,632	533.03	.0246
Number 25	1951	9,743	464.73	.0477
Number 26	1953	13,070	398.92	.0305
Number 28	1953	24,513	381.03	.0155
Total or average	-	88,652	2,493.26	0.0281
Grand total or average		146,982	4,151.34	.0282

Miscellaneous Servicing

The miscellaneous servicing expenses shown in table 15 consist of charges for lubrication and antifreeze. Of the 2 items, lubrication expenses make up the greater proportion of these costs. Charges for the antifreeze do not exceed $2.70 per vehicle. This price represents wholesaler's cost, since the firm regularly stocks the item for resale purposes.

As indicated in table 15, the miscellaneous servicing expenses, both on a per-mile or per-vehicle basis are small. They are by far the smallest of the several expense items. (See table 20.)

Although the firm's stated policy is to have the trucks lubricated every 2,000 miles, or 30-45 days (whichever is more frequent), 3 of the trucks (numbers 10, 17, and 25) were lubricated only 4 times during the year. 5/

5/ The lubrication is done by an independent garage. It is the responsibility of each driver to see that his truck is lubricated at the proper time.

Table 15.--Miscellaneous servicing expense of wholesaler's delivery trucks December 1, 1953 - November 30, 1954

Item	Year of manufacture	Expense per vehicle	Miles traveled	Expense per vehicle-mile
		Dollars	Miles	Dollars
Straight truck				
Number 10	1948	9.80	4,520	0.0022
Number 11	1954	15.80	8,038	.0020
Number 12	1950	13.80	8,520	.0016
Number 16	1952	17.80	17,308	.0010
Number 17	1948	10.25	6,004	.0017
Number 20	1950	16.70	13,940	.0012
Total or average	-	84.15	58,330	0.0014
3-axle tractor-semitrailer combination				
Number 14	1950	20.70	19,694	0.0010
Number 24	1951	22.70	21,632	.0010
Number 25	1951	9.80	9,743	.0010
Number 26	1953	15.80	13,070	.0012
Number 28	1953	23.80	24,513	.0010
Total or average	-	92.80	88,652	0.0010
Grand total or average		176.95	146,982	0.0012

While the distance traveled between lubrications for each of these trucks was below or not far above the 2,000-mile limit, the time lag of approximately 3 months per lubrication was double the maximum period accepted by the firm. It is notable that these 3 vehicles were among those with the highest repairs and parts expense (table 14). Truck maintenance men have stated that delivery trucks which operate fairly constantly throughout the year even though at relatively low mileages (the 3 mentioned above traveled between 4,500 and 9,700 miles) need to be lubricated more than 4 times. They have further stated that mileage traveled is not an accurate guide to the need for lubrication. For example, it was pointed out that a single day's travel in rainy weather might necessitate a lubrication because of the splashing of water against the wheels and undercarriage of the truck.

Depreciation

Due to wear and tear, lapse of time, obsolescence, etc., the fixed assets of a business, such as trucks used in delivery operations, have a limited

Table 16.--Depreciation expense of wholesaler's delivery trucks, December 1, 1953 - November 30, 1954

Item	Year of manufacture	Distance traveled	Expense per vehicle	Expense per vehicle-mile
		Miles	Dollars	Dollars
Straight truck				
Number 10	1948	4,520	1/	---
Number 11	1954	8,038	935.50	0.1164
Number 12	1950	8,520	582.29	.0683
Number 16	1952	17,308	557.28	.0322
Number 17	1948	6,004	1/	---
Number 20	1950	13,940	833.00	.0598
Total or average	-	58,330	2,908.07	0.0499
3-axle tractor-semitrailer combination				
Number 14 2/	1950	19,694	1,175.00	0.0597
Number 24 2/	1951	21,632	1,290.37	.0597
Number 25 2/	1951	9,743	354.40	.0364
Number 26 2/	1953	13,070	1,025.00	.0784
Number 28 2/	1953	24,513	1,025.00	.0418
Total or average	-	88,652	4,869.77	0.0549
Grand total or average		146,982	7,777.84	0.0529

1/ Vehicle is fully depreciated.
2/ Consists of the depreciation expense for the tractors only. All of the semitrailers are fully depreciated.

service life. In recognition of this fact, a depreciation expense account is established for the purpose of spreading the original cost of each truck as uniformly as possible over its productive life.

This is accomplished in table 16 by the use of two different methods of computing depreciation. For truck No. 11, the sum of the years-digits method is used. For all other vehicles, the straight-line method is used. Straight-line depreciation is computed for these vehicles by taking the original cost of each, less the estimated salvage value at the end of its use by this firm, and dividing by 4--the estimated number of years of useful life to be obtained from the trucks.

As a result of a recent change in Federal income tax law, the sum of the years-digits method of depreciation may be used for property having a useful

life of 3 years or more which is acquired by the taxpayer new after December 31, 1953. Truck No. 11 comes under this category. Depreciation expense by this method is computed as follows:

1. A different rate of depreciation--expressed as a fraction--is applied each year to the original cost of the truck, less its salvage value.

2. This rate of depreciation, or fraction, is one the numerator of which is the same as the number of 12-month periods remaining in the estimated useful life of the truck, including the period for which the depreciation is being computed. The denominator, on the other hand, is the sum of the numbers representing the successive 12-month periods in the estimated useful life of the truck. For example, truck No. 11 cost $2,788.75, has an estimated useful life of 4 years, and an estimated salvage value of $450. The denominator of the fraction to be used is 10 (4+3+2+1), and remains the same throughout the life of the truck. The numerator of the fraction is 4 for the first year, 3 for the second year, 2 for the third year, and 1 for the last year. The depreciation expense for the first year is thus: ($2,788.75 - $450) x 4/10. For the second year it is ($2,788.75 - $450) x 3/10.

The aggregate depreciation is the same, during the vehicle's life, regardless of which of these two methods is used in computing depreciation. However, as the above computations show, the sum of the years-digits method permits a larger depreciation allowance in the early years of the truck's life. It is thus more in line with actual market value reductions in trucking equipment than is the straight-line method of depreciation. In addition, the method makes possible a more uniform allocation of trucking expenses. For example, in the first year or so, when tires, repairs, and parts expenses are light, depreciation expenses are the heaviest. But in the latter years of the truck's useful life, when these previously mentioned expenses are becoming larger, depreciation expenses decline.

Since only 4 of the 6 straight trucks and 5 truck-tractors have any depreciation expense, this item is probably less for the Baltimore wholesale firm than for other wholesalers with delivery operations of comparable size. As previously pointed out, all of the semitrailers are fully depreciated.

Insurance

Truck insurance expense arises from the desire of the trucker--in this case the grocery wholesaler--to insure (1) against his legal liability for personal injury, death, or property damage arising from operation of his trucks, and (2) protection against loss of or damage to his trucks from such hazards as fire, theft, and collision.

The State of Maryland does not require truck operators to carry liability insurance routinely, but the State does require the depositing of security in the form of a bond or insurance policy following a motor vehicle accident involving bodily injury or death or damage to property in excess of $75. The bond or policy must provide for a minimum coverage of $10,000 because of bodily injury to or death of 1 person in any one accident, $20,000 for such harm to 2 or more persons, and $5,000 for property damage.

The insurance expense shown in table 17 provides for public liability coverage of $100,000 for 1 person, $300,000 for injury to or death of 2 or more persons in any one accident, and $5,000 for property damage in any one accident. Information was not available as to the amount of liability insurance typically carried on private trucking operations in Maryland. However, the Baltimore wholesaler's liability insurance coverage, although substantially above the minimum required by Maryland State law, is not out of line with that commonly carried by for-hire truckers. The combination of higher court costs, and greater frequency in recent years in granting large judgments in motor vehicle cases necessitates this degree of insurance coverage.

The balance of the insurance expense in table 17 consists of collision coverage, on a $100 deductible basis, and "comprehensive fire and theft insurance." The collision insurance gives the wholesaler protection against loss of or damage to his vehicles beyond the first $100 of such loss or damage in any one accident. The comprehensive insurance includes protection not only against the hazards of fire and theft but also against such other hazards as falling objects, earthquake, windstorm, hail, water, flood, and vandalism. All damage to the vehicle by collision or upset is excepted from this coverage.

Insurance expense is a large item in the operation of trucks. It accounts for approximately 18 percent of the total nonlabor expense. Within wide limits, the amount of insurance expense for any given truck has no relation to the number of miles it travels or the number of ton-miles of freight it hauls. Hence the table shows a far higher insurance expense per mile for the comparatively little used trucks than for the extensively used ones.

License Fees and Taxes

Motor vehicle license fees for private motor carriers, such as the Baltimore wholesale grocery firm operating in the State of Maryland, vary with the type of vehicle; that is, straight trucks, truck-tractors, and semitrailers. In addition, the fees are graduated upward within each of these groups--except for the truck-tractors--in accordance with increases in the manufacturer's shipping weight and maximum gross weight limits for each of the vehicles. For example, trucks 10, 11, 12, and 16 all fall within the category of 4,001 to 5,000 pounds manufacturer's shipping weight and within the maximum gross weight limit of 20,000 pounds. The maximum gross weight limit is what the owner specifies in paying the registration fee. Within reason, the owner is free to decide, at that time, what limit he will specify. Hence this limit reflects both the size of the truck and the use to which the owner puts it.

Table 17.--Insurance expense of wholesaler's delivery trucks, December 1, 1953 - November 30, 1954

Item	Year of manufacture	Public liability and property damage	Collision ($100 deductible) and comprehensive	Total	Distance traveled	Expense per vehicle-mile
		Dollars	Dollars	Dollars	Miles	Dollars
Straight truck						
Number 10	1948	189.12	64.00	253.12	4,520	0.0560
Number 11	1954	236.40	88.90	325.30	8,038	.0405
Number 12	1950	189.12	75.00	264.12	8,520	.0310
Number 16	1952	189.12	85.60	274.72	17,308	.0159
Number 17	1948	189.12	65.00	254.12	6,004	.0423
Number 20	1950	189.12	101.00	290.12	13,940	.0208
Total or average	-	1,182.00	479.50	1,661.50	58,330	0.0285
3-axle tractor-semi-trailer combination						
Number 14	1950	492.28	223.00	715.28	19,694	0.0363
Number 24	1951	492.28	226.00	718.28	21,632	.0332
Number 25	1951	471.77	147.50	619.27	9,743	.0636
Number 26	1953	471.77	188.70	660.47	13,070	.0505
Number 28	1953	492.28	214.20	706.48	24,513	.0288
Total or average	-	2,420.38	999.40	3,419.78	88,652	0.0386
Grand total or average		3,602.38	1,478.90	5,081.28	146,982	0.0346

In contrast, truck No. 17 has a maximum gross weight limit of 17,000 pounds and a correspondingly lower manufacturer's shipping weight. Truck No. 20, on the other hand, has a maximum gross weight limit of 32,000 pounds, and a manufacturer's shipping weight in the 6,001-to 7,500-pound category. The above differences in shipping weights and gross weight limits make for the variations in the license fees of the straight trucks.

While all 5 truck-tractors were assessed a flat fee of $65 per vehicle, the license fees for the semitrailers were assessed on the basis of a State of Maryland regulation which provides that, "for each two truck-tractors registered by a shuttle or relay system operator, there may be secured two additional semitrailer registrations, one without cost, the other at half weight fee." Because this wholesaler operates 5 truck-tractors and 9 semitrailers under the relay system, only 6 full license fees were required to be paid for the 9 semitrailers. The fee for 5 of the semitrailers was $115 each, for the sixth it was $145. This latter trailer (No. 26A) has a maximum gross weight of 38,000 pounds in contrast to 34,000 pounds for the other semitrailers. Because vehicles 14, 24, and 28 had by far the greatest mileage of the 5 tractor-semitrailers, the sixth trailer license fee was attributed to them. It was divided equally among them.

The tax expense shown in table 18 represents a 1-year allocation of a 2-percent excise tax which is levied by the State of Maryland for each Certificate of Title on the purchase price of new motor vehicles, including trucks, or the fair market value of used vehicles. In addition, a $1 fee is levied for each Certificate of Title issued. This fee, as well as the 2 percent excise tax, is prorated over the useful life of the trucks.

Interest

Interest is generally defined as an amount paid for the use of money, being a certain percent of the amount loaned over a given period of time, such as a year. Since the Baltimore firm, however, purchases its vehicles on a cash basis rather than having them financed, the interest expense in table 19 is represented by the interest foregone on these sums.

Because of the fact, as previously stated, that all 9 of the semitrailers and 2 of the straight trucks are fully depreciated, neither interest expense nor depreciation expense are chargeable to these vehicles. As a result, like depreciation, the interest expense of this firm is undoubtedly less than that of a wholesaler with a comparable size trucking operation.

The interest expense was computed by utilizing the following formula:

$$I = (P - S)\frac{r}{2}\frac{(n+1)}{n} + Sr,$$

where "I" is the annual cost, "P" the original investment, "r" the rate of interest, "n" the years of expected use, and "S" the salvage value at end of useful life. 6/

6/ This formula has been previously used for computing interest costs on wholesaler's trucking equipment. See Robert H. Reed, Truck Hauling and Delivery Costs Representing Island Conditions, University of Hawaii Agricultural Experiment Station, May 1953.

Table 18.--License and tax expense of wholesaler's delivery trucks, December 1, 1953 - November 30, 1954

Item	Year of manufacture	License fees	Taxes	Total	Distance traveled	Expense per vehicle-mile
		Dollars	Dollars	Dollars	Miles	Dollars
Straight truck						
Number 10	1948	50.00	---	50.00	4,520	0.0111
Number 11	1954	50.00	14.19	64.19	8,038	.0080
Number 12	1950	50.00	11.90	61.90	8,520	.0073
Number 16	1952	50.00	11.40	61.40	17,308	.0035
Number 17	1948	33.00	---	33.00	6,004	.0055
Number 20	1950	135.00	16.91	151.91	13,940	.0109
Total or average	-	368.00	54.40	422.40	58,330	0.0072
3-axle tractor-semitrailer combination 1/						
Number 14	1950	218.33	24.20	242.53	19,694	0.0123
Number 24	1951	218.33	26.51	244.84	21,632	.0113
Number 25	1951	180.00	9.56	189.56	9,743	.0195
Number 26	1953	210.00	21.20	231.20	13,070	.0177
Number 28	1953	218.33	21.20	239.53	24,513	.0098
Total or average	-	1,044.99	102.67	1,147.66	88,652	0.0129
Grand total or average		1,412.99	157.07	1,570.06	146,982	0.0107

1/ See table 13 (p. 26) for the number of trailers assigned to each tractor-semitrailer combination.

The salvage value ranged from $450 to $1,200, depending upon the make and type of vehicle. An assumed interest rate of 4 percent per annum (as suggested by officials of the firm) and an estimated period of useful life of 4 years were used in the formula. As mentioned previously, the delivery trucks are depreciated over a 4-year period.

Total Nonlabor Expenses

The costs of operating the delivery trucks, exclusive of wages, for the period December 1, 1953 to November 30, 1954, were approximately $28,000, or about 19 cents per mile (table 20). Operating costs for the tractor-semitrailers were about 3 cents per mile greater than for the straight trucks.

Table 19.--Interest expense of wholesaler's delivery trucks, December 1, 1953 - November 30, 1954

Item	Year of manufacture	Total expense	Distance traveled	Expense per vehicle-mile
		Dollars	Miles	Dollars
Straight truck				
Number 10	1948	1/	4,520	1/
Number 11	1954	76.47	8,038	0.0095
Number 12	1950	64.98	8,520	.0076
Number 16	1952	62.48	17,308	.0036
Number 17	1948	1/	6,004	1/
Number 20	1950	101.30	13,940	.0073
Total or average	-	305.23	58,330	0.0052
3-axle tractor-semitrailer combination 2/				
Number 14	1950	132.51	19,694	0.0067
Number 24	1951	144.04	21,632	.0067
Number 25	1951	51.80	9,743	.0053
Number 26	1953	120.50	13,070	.0092
Number 28	1953	120.50	24,513	.0049
Total or average	-	569.35	88,652	0.0064
Grand total or average		874.58	146,982	0.0060

1/ These vehicles have no interest expense, since they are fully depreciated.

2/ Includes interest expense for the truck tractors only. All of the semitrailers are fully depreciated.

A rather wide variation is to be found in the per mile costs of the individual trucks. For example, total expenses (variable and fixed) for the straight trucks range from approximately 10½ cents to 24 cents per mile, while for the tractor-semitrailers the range is from about 16 cents to 26 cents per mile. Among the straight trucks and among the tractor-semitrailers, the lowest variable as well as fixed expense per mile was that of the vehicles which had traveled the greatest number of miles during the period (trucks 16 and 28).

By definition, fixed expenses per unit (in this case per mile) decrease as the total number of units or miles is increased. In contrast, variable expenses per unit are expected to increase as the total number of units is

Table 20.--Summary of nonlabor variable and fixed expenses of wholesaler's delivery trucks, December 1, 1953-November 30, 1954

Item	Year of manufacture	Distance traveled	Variable expenses: Gasoline and oil	Tires	Repairs and parts	Miscellaneous servicing	Total variable expenses	Variable expenses per vehicle mile	Fixed expenses: Depreciation	Insurance	Licenses and taxes	Interest	Total fixed expenses	Fixed expenses per vehicle mile	Total expenses: Total variable and fixed expenses	Variable and fixed expenses per vehicle mile
		Miles	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Straight truck:																
Number 10	1948	4,520	213.10	110.02	200.17	9.80	533.09	0.1179	1/	253.12	50.00	1/	303.12	0.0671	836.21	0.1850
Number 11	1954	8,038	309.20	75.19	109.16	15.80	509.35	.0634	935.50	325.30	64.19	76.47	1,401.46	.1744	1,910.81	.2377
Number 12	1950	8,520	343.00	142.94	296.92	13.80	796.66	.0935	582.29	264.12	61.90	64.98	973.29	.1142	1,769.95	.2077
Number 16	1952	17,308	411.22	211.48	207.41	17.80	847.91	.0490	557.28	274.72	61.40	62.48	955.88	.0552	1,803.79	.1042
Number 17	1948	6,004	290.70	198.36	478.58	10.25	977.89	.1629	1/	254.12	33.00	1/	287.12	.0478	1,265.01	.2107
Number 20	1950	13,940	485.50	208.90	365.84	16.70	1,076.94	.0773	833.00	290.12	151.91	101.30	1,376.33	.0987	2,453.27	.1760
Total or average		58,330	2,052.72	946.89	1,658.08	84.15	4,741.84	.0813	2,908.07	1,661.50	422.40	305.23	5,297.20	.0908	10,039.04	.1721
3-axle tractor-semitrailer combination 2/																
Number 14	1950	19,694	942.88	270.31	715.55	20.70	1,949.44	.0990	1,175.00	715.28	242.53	132.51	2,265.32	.1150	4,214.76	.2140
Number 24	1951	21,632	1,114.46	306.37	533.03	22.70	1,976.56	.0914	1,290.37	718.28	244.84	144.04	2,397.53	.1108	4,374.09	.2022
Number 25	1951	9,743	385.63	164.21	464.73	9.80	1,024.37	.1051	354.40	619.27	189.56	51.80	1,215.03	.1247	2,239.40	.2298
Number 26	1953	13,070	721.99	249.88	398.92	15.80	1,386.59	.1061	1,025.00	660.47	231.20	120.50	2,037.17	.1559	3,423.76	.2620
Number 28	1953	24,513	1,002.15	407.91	381.03	23.80	1,814.89	.0740	1,025.00	706.48	239.53	120.50	2,091.51	.0853	3,906.40	.1594
Total or average		88,652	4,167.11	1,398.68	2,493.26	92.80	8,151.85	.0920	4,869.77	3,419.78	1,147.66	569.35	10,006.56	.1129	18,158.41	.2048
Grand total or average		146,982	6,219.83	2,345.57	4,151.34	176.95	12,893.69	.0877	7,777.84	5,081.28	1,570.06	874.58	15,303.76	.1041	28,197.45	.1918

1/ These vehicles are fully depreciated.

2/ Includes depreciation and interest expense for the truck tractors only. All of the semitrailers are fully depreciated.

increased. The failure of the variable expenses in table 20 to conform with generally accepted economic behavior can be largely explained by the fact that there is considerable diversity among these trucks as to age, motor condition, and type of route traveled. Trucks 16 and 28 had the greatest tire expense in each of their respective groups but the repairs and parts expense for the 2 vehicles was among the lowest. The latter fact is indicative of the superior condition of these 2 vehicles.

The large total expenses per mile for truck number 11 is due to its high fixed expenses--primarily depreciation. As previously mentioned, this vehicle was purchased after December 31, 1953, and thus its depreciation expense was computed by the sum of the years-digits method which for this particular vehicle permitted a 40-percent writeoff in the first year. At the same time, the vehicle's newness meant that it was in good operating condition. Hence its low variable expense.

The effect of large fixed expenses upon total expenses per vehicle-mile is further illustrated by comparing trucks 26 and 28. The difference in the total fixed expenses of these 2 vehicles is less than $55, but because of the large difference in miles traveled, the fixed expenses per vehicle-mile for truck No. 26 is almost double that of truck No. 28.

A striking fact in the relationship of variable and fixed expenses as shown by table 20 is that in all cases, with the exception of trucks 10 and 17, the fixed expenses per vehicle-mile exceed the variable expenses. The fixed expenses per vehicle-mile for these 2 trucks are low because they are fully depreciated and thus have no depreciation or interest expense.

Fixed expenses per unit hauled can be lowered by either or both of the following methods: (1) by increased utilization of the trucks, as by greater use on return loads (in-bound haulage of groceries to the wholesaler's warehouse); (2) by consolidation of routes, along with an eventual reduction either in the size or in the number of trucks. Such consolidation could also reduce the fixed expenses per vehicle-mile.

The firm needs to investigate the feasibility of applying these methods of reducing its fixed expenses per vehicle-mile.

LABOR EXPENSE PER VEHICLE-MILE

The labor expense for the wholesaler's delivery trucks averages approximately 31½ cents per vehicle-mile (table 21). This expense consists of the wages and fringe benefits of the driver or of the driver and helper, where 2 men were used per vehicle. The only nonoperating employees who are directly involved in the wholesaler's truck operations are dispatchers. Their compensation is excluded from the labor expense which this report covers.

The average labor expense per hour (column 4) was computed by first determining the gross pay--including overtime--for each of the drivers and helpers in a representative workweek. There is a wage differential between

Table 21.--Labor expense per vehicle-mile of wholesaler's delivery trucks, 19 trips in selected periods, 1954

Item	Men in crew 1/	Trips	Average labor expense per hour	Total time on trips	Total labor expense	Distance traveled	Labor expense per vehicle-mile
	Number	Number	Dollars	Hours	Dollars	Miles	Dollars
Straight truck							
Number 10	1	1	2.02	7.45	15.05	50.60	0.2974
Number 11	1	1	2.05	6.67	13.67	15.40	.8877
Number 12	1	2	1.83	13.48	24.67	60.70	.4064
Number 16	1	3	1.92	20.55	39.46	162.90	.2422
Number 17	1	3	1.91	24.75	47.27	124.80	.3788
Number 20	2	1	3.59	8.18	29.37	36.40	.8069
Total or average	-	11	2.09	81.08	169.49	450.80	0.3760
3-axle tractor-semi-trailer combination							
Number 14	2	2	3.85	20.90	80.47	289.60	0.2779
Number 24	2	3	3.86	31.95	123.33	405.00	.3045
Number 25	2	1	4.07	13.80	56.17	255.30	.2200
Number 26	2	1	3.91	9.93	38.83	87.70	.4428
Number 28	2	1	3.90	9.27	36.15	117.30	.3082
Total or average	-	8	3.90	85.85	334.95	1,154.90	0.2900
Grand total or average		19	3.02	166.93	504.44	1,605.70	0.3142

1/ Crew consisted of driver or of driver and helper. For a 2-man crew, the labor expense is for the 2 men combined.

the drivers and helpers of 22½ cents an hour. To wages was added a prorata share of the expenses incurred by the firm for fringe benefits--paid vacations, a health and welfare contribution as called for by the union contract, insurance premiums for workmen's compensation, Federal and State taxes for unemployment compensation, and the Federal tax for old-age and survivors' insurance.

The average labor expense per vehicle-mile for the straight trucks exceeds that of the tractor-trailers by approximately 9 cents. The 2 straight trucks with the greatest labor expense per mile (Nos. 11 and 20) are those used on the congested urban routes. Although these routes are quite short, they require a relatively large amount of delivery time. As mentioned previously, this results from the delays in moving through heavily congested downtown streets and alleys, and from hand-carrying or hand-trucking the merchandise relatively long distances.

The smaller labor expense on a vehicle-mile basis for deliveries by the tractor-trailers, despite the use of 2-man crews, is explained by the fact that these vehicles are used predominately on relatively long, less congested rural routes.

LABOR EXPENSE PER TON-MILE

On a ton-mile basis the labor expense for trucks 11 and 20 is still high, although in a comparison between these 2 trucks, the expense for No. 20 is more favorable when measured by ton-miles than by vehicle-miles (table 22). For example, on a vehicle-mile basis the labor expense for truck No. 20 was 91 percent of that for truck No. 11, but on a ton-mile basis it is only 45 percent. This is accounted for by the fact that No. 20 hauled twice the tonnage of No. 11, and traveled more than twice the distance. The remaining straight trucks show no drastic change in their relative rank on labor expense per ton-mile as compared with that per vehicle-mile.

Using the ton-mile instead of the vehicle-mile as a measure of labor expense for the tractor-trailers results in some changes in the rankings of these vehicles. For example, truck No. 25 had the lowest labor expense per vehicle-mile, but, when labor expense is compared by ton-miles, the figure for this truck is one and one-half times the average. Similarly, truck 24 with a ton-mile labor expense of $0.0153--the lowest in the group--has a vehicle-mile labor expense slightly larger than the average for the tractor-trailers. At the same time, truck No. 26 has both the highest labor expense per vehicle-mile and per ton-mile in the tractor-trailer group. The short distance traveled and small amount hauled account for this fact.

AVERAGE LABOR AND NONLABOR EXPENSE PER VEHICLE-MILE

There is approximately a 6 to 4--actually 62/38--ratio in the labor expense versus nonlabor expense per vehicle-mile for the wholesaler's delivery trucks (table 23). Labor expenses for drivers, or drivers and

Table 22.--Labor expense per ton-mile of wholesaler's delivery trucks, 19 trips in selected periods, 1954

Item	Trips	Total amount hauled	Distance traveled	Total ton-miles 1/	Total labor expense	Labor expense per ton-mile
	Number	Tons	Miles	Number	Dollars	Dollars
Straight truck						
Number 10	1	6.10	50.60	154.33	15.05	0.0975
Number 11	1	4.00	15.40	30.80	13.67	.4438
Number 12	2	11.00	60.70	333.85	24.67	.0739
Number 16	3	16.00	162.90	1,303.20	39.46	.0303
Number 17	3	16.50	124.80	1,029.60	47.27	.0459
Number 20	1	8.00	36.40	145.60	29.37	.2017
Total or average	11	61.60	450.80	2,997.38	169.49	0.0565
3-axle tractor-semi-trailer combination						
Number 14	2	22.50	289.60	3,258.00	80.47	0.0247
Number 24	3	39.75	405.00	8,049.38	123.33	.0153
Number 25	1	12.00	255.30	1,531.80	56.17	.0367
Number 26	1	11.00	87.70	482.35	38.83	.0805
Number 28	1	10.75	117.30	630.49	36.15	.0573
Total or average	8	96.00	1,154.90	13,952.02	334.95	0.0240
Grand total or average	19	157.60	1,605.70	16,949.40	504.44	0.0298

1/ Ton-miles are computed on the assumption that all tonnage traveled an average distance of one-half the length of the entire trip.

Table 23.--Labor and nonlabor expense per vehicle-mile of wholesaler's delivery trucks, selected periods, 1953-54

Item	Average labor expense per vehicle-mile	Average nonlabor expense per vehicle-mile
	Dollars 1/	Dollars 2/
Straight truck		
Number 10	0.2974	0.1850
Number 11	.8877	.2377
Number 12	.4064	.2077
Number 16	.2422	.1042
Number 17	.3788	.2107
Number 20	.8069	.1760
Total or average	0.3760	0.1721
3-axle tractor-semitrailer combination		
Number 14	0.2779	0.2140
Number 24	.3045	.2022
Number 25	.2200	.2298
Number 26	.4428	.2620
Number 28	.3082	.1594
Total or average	0.2900	0.2048
Grand total or average	0.3142	0.1918

1/ Computed on the basis of 19 trips made by the wholesaler's delivery trucks in July, August, and December 1954. See table 21.
2/ Represents nonlabor expenses for the period December 1, 1953 to November 30, 1954. See table 20.

helpers, equal about 31 cents per vehicle-mile, while the nonlabor expense of the trucks is about 20 cents. As stated in table 23, the labor expense per vehicle-mile is based on that incurred for the 19 trips in the study, while the nonlabor expense is for the period December 1, 1953 to November 30, 1954. The representativeness of the labor expense data for the shorter period is indicated by the fact that, for the period September 1, 1953 to August 31, 1954 (the wholesale firm's 1954 fiscal year), wages of the delivery personnel also amounted to 62 percent of the total delivery expenses while the remaining 38 percent consisted of the nonlabor expenses.

The average nonlabor expense per vehicle-mile for the straight trucks is approximately 3 cents less than that for the tractor-semitrailers. In contrast, the average labor expense for the former is about 6½ cents more than

for the latter, despite the fact that 5 out of 6 straight trucks had 1-man crews whereas all 5 tractor-semitrailers had 2-man crews. Total expenses on a vehicle-mile basis are thus somewhat larger for the straight trucks than for the tractor-semitrailers.

In examining the Baltimore wholesaler's nonlabor expense per vehicle-mile, a basis of comparison is afforded by similar operating statistics for Government vehicles. For example, for the year ending June 30, 1954, the combined operation and maintenance expense for Federal Government vehicles in the gross weight categories of the wholesaler's delivery trucks (17,000 to 24,499 and 24,500 and over) averaged $0.1789 and $0.3034 per vehicle-mile respectively. These data are for vehicles operated only by civilian agencies, and exclude depreciation expense as well as driver wages. By comparison, the total nonlabor expenses of the wholesaler's delivery trucks, including depreciation in the above gross weight categories, average $0.1721 and $0.2048 respectively. When depreciation expense is excluded, these nonlabor expenses fall to $0.1222 for the straight trucks, and to $0.1499 for the tractor-semitrailers.

DELIVERY EXPENSES BY VALUE OF ORDER AND LOCATION OF BUYER

The determination of the labor and nonlabor delivery expenses for orders of varying size, delivered in different types of areas, reveals some striking facts. One of the most important of these is that the costs of delivering orders up to $300 in rural areas are approximately the same for orders of all sizes. In table 24, the average labor and nonlabor expenses for delivering orders under $25 is $2.67; in the $25-$74.99 group the delivery expenses are $2.74; and in the $75-$149 and $150-$299.99 groups, they are $2.68. It is only when the value of the orders reach the open-end category of "$300 and over" that the delivery expenses increase sharply. Here they jump to $6.11.

This large increase is due to the fact that in this latter group the orders ranged in value from $313 to $1,680. The unloading time, in particular, increases substantially for these large orders. For example, rural orders in this group had an average unloading time of 49.81 minutes. In contrast, the average unloading time for rural orders in the other 4 categories ranged from 16.75 minutes down to 3.34 minutes. (Table 11.) The higher average unloading time for orders in the $300-and-over category in turn is reflected in a higher average labor expense per order.

Table 11 also shows that the average unloading time in each of the 4 smaller-size groups is less for rural orders than for orders delivered in congested urban or other urban areas. In the $300-and-over category, however, the average unloading time is greater for rural orders than for those orders delivered to congested urban or other urban areas.

Another interesting fact revealed in table 24 is the heavy per-mile cost of delivering orders in congested urban areas. In these areas they range from 60 to 83 cents. By comparison the costs per mile for rural orders range from 45 to 53 cents.

Table 24.--Labor and nonlabor delivery expenses by value of order and location of buyer, selected periods, 1954 1/

Value of order and location of buyer	Orders	Total delivery time 2/	Average delivery time per order 2/	Average labor expense per order 3/	Average nonlabor expense per order	Average labor and nonlabor expense per order	Average labor expense per order per mile 4/	Average nonlabor expense per order per mile 4/	Average labor and nonlabor expense per order per mile	Average labor expense per dollar of sales	Average nonlabor expense per dollar of sales	Average labor and nonlabor expense per dollar of sales
	Number	Minutes	Minutes	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Under $25.00:												
Congested urban	12	177.50	14.79	0.70	0.23	0.93	0.6179	0.2083	0.8262	0.0443	0.0150	0.0593
Other urban	9	127.31	14.15	.63	.30	.93	.3546	.1713	.5259	.0361	.0174	.0535
Rural	19	345.03	18.16	1.43	1.24	2.67	.2383	.2067	.4450	.0989	.0857	.1846
Total or average	40	649.84	16.25	1.03	.73	1.76	.2868	.2029	.4897	.0665	.0470	.1135
$25.00-$74.99:												
Congested urban	34	683.78	20.11	.88	.25	1.13	.6182	.1778	.7960	.0193	.0056	.0249
Other urban	55	1,166.79	21.21	.91	.50	1.41	.3249	.1785	.5034	.0193	.0106	.0299
Rural	88	1,965.51	22.34	1.52	1.22	2.74	.2565	.2077	.4642	.0314	.0255	.0569
Total or average	177	3,816.08	21.56	1.21	.81	2.02	.2953	.1995	.4948	.0254	.0172	.0426
$75.00-$149.99:												
Congested urban	15	377.12	25.14	.82	.27	1.09	.5546	.1860	.7406	.0077	.0026	.0103
Other urban	30	757.33	25.24	1.07	.54	1.61	.3496	.1772	.5268	.0105	.0054	.0159
Rural	49	1,249.12	25.49	1.48	1.20	2.68	.2532	.2049	.4581	.0147	.0119	.0266
Total or average	94	2,383.57	25.36	1.25	.84	2.09	.2919	.1975	.4894	.0122	.0083	.0205
$150.00-$299.99:												
Congested urban	10	359.50	35.94	.91	.39	1.30	.4645	.2005	.6650	.0046	.0020	.0066
Other urban	7	247.41	35.34	1.26	.78	2.04	.3533	.2202	.5735	.0061	.0039	.0100
Rural	26	841.59	32.37	1.57	1.11	2.68	.2680	.1904	.4584	.0077	.0055	.0132
Total or average	43	1,448.50	33.69	1.36	.89	2.25	.2984	.1952	.4936	.0068	.0044	.0112
$300.00 and over:												
Congested urban	1	37.08	37.08	.74	.15	.89	.4980	.1042	.6022	.0022	.0005	.0027
Other urban	2	111.60	55.80	.86	.44	1.30	.4126	.2088	.6214	.0021	.0011	.0032
Rural	12	999.30	83.28	3.77	2.34	6.11	.3280	.2029	.5309	.0060	.0037	.0097
Total or average	15	1,147.98	76.53	3.18	1.94	5.12	.3321	.2021	.5342	.0055	.0033	.0088
Grand total or average	369	9,445.97	25.60	1.29	.87	2.16	0.2974	0.1990	0.4964	0.0133	0.0089	0.0222

1/ Labor expense was computed for each of the 19 trips made by the wholesaler's delivery trucks in July, August, and December 1954 (table 21). Nonlabor expense was determined for those same trips--on the basis of the nonlabor expense per vehicle-mile during the period December 1, 1953 to November 30, 1954. For each truck covered by the study, the nonlabor expense per vehicle mile (table 20) was multiplied by the number of vehicle-miles run by that truck on the trip or trips which the study analyzes.

2/ The delivery time of each order was determined by (1) charging to it the total time spent at the particular stop in unloading, checking, collecting (where c.o.d.), etc., and (2) allocating the total driving time of each trip, from the warehouse back to the warehouse, equally among the several orders delivered. In those few cases where 2 orders were unloaded at one stop, the total time at the stop was allocated in proportion to the number of pieces per order.

3/ The labor expense of each truck, computed as stated in footnote 1, was allocated among the orders delivered by that truck, The allocation was based on the delivery time of each order, computed as stated in footnote 2.

4/ The distance traveled by each order was determined by taking the total distance of the particular trip and allocating it equally among the orders. The nonlabor expense for each order was computed by multiplying the distance (as thus determined) by the particular vehicle's nonlabor expense per vehicle-mile.

The ratio of labor to nonlabor expense per mile is considerably higher for congested-urban orders than for rural orders. For the former it runs as high as 4.8 to 1, while for the latter the high is only 1.6 to 1.

The average labor and nonlabor expense for all orders equaled $2.16 per order. These expenses were about 50 cents per mile and about 2 cents per dollar of sales. In each of these categories of expense; that is, per order, per mile, and per dollar of sales, the average labor expense exceeded the nonlabor expense.

When the order was under $25 in size, the average figure for labor and nonlabor delivery expense per dollar of sales was above 5 cents, for customers in congested urban areas, for those in other urban areas, and for those in rural areas--the amount in this last instance rising above 18 cents. When the order was in the $25-$74.99 range, the corresponding figure for customers in rural areas was also above 5 cents.

The firm states that, on the basis of averaging several years' experience, its cost of goods sold is approximately 92 cents of each dollar of sales, leaving a gross profit of only 8 cents. Since all general and administrative supplies and expenses, salaries and wages, light and heat, advertising, and delivery must be deducted from the gross profit before arriving at net profit on sales, delivery expenses amounting to 5 cents per dollar of sales are obviously excessive.

CONCLUSIONS

Recommendations Based on Time Study Analysis and Interviews with Delivery Personnel

On the basis of the time analysis and interviews with delivery personnel, the following recommendations are offered concerning equipment, trip routing, and unloading procedure. These proposals are designed to increase the efficiency of the wholesaler's truck delivery operation. This increased efficiency will in turn be reflected in improved services, lower costs, or both.

Equipment

1. In deliveries on the rural routes, on several occasions the presence of a side door on each side of the trailer would have greatly facilitated the unloading operation. Since the trailers of the wholesale firm are equipped with only one side door--located on the right side of the trailer--servicing a store on the left side of the highway involves either turning the vehicle completely around (once to unload, and then again to resume the trip), or unloading from the end doors. Either method results in delay.

In the light of these facts, trailers purchased in the future for use on the rural routes should be equipped with doors on both the curb side and the road side of the trailer. Ability to unload from either side will save a

substantial amount of maneuvering time at many of the stops. Under the present scheme of a single side door, it was necessary in some cases to drive an additional couple of miles in order to find a place to turn the truck around so that the merchandise could be unloaded from the side door. Turning a large tractor-trailer around on narrow rural roads involves hazard to the wholesaler's driver and helper, to other people driving along the highway, and to the various vehicles involved.

In addition, the 2 side doors will permit some cross-ventilation. This will be important to the driver in breaking down the load on hot days.

A leading truck-trailer manufacturer has estimated that, depending upon the material of which the trailer is constructed, the cost of installation of an additional side door when ordered as part of the equipment at the time of manufacture would vary from $80 to $350.

2. One of the trailers operated by the wholesale firm is equipped with a very heavy movable tailgate. This can be swung up to meet a set of short rear doors. Each time the truck is opened the tailgate must be let down to a horizontal position and fastened with a chain. Conversely, when the truck is closed up, it is necessary to push the tailgate up into place, and readjust and fasten the chain. Considerable exertion is required on the part of both the driver and helper to perform these tasks. As one means of greatly reducing this heavy labor, it is proposed that flush doors be provided for this trailer. These would make it possible to leave the heavy tailgate permanently suspended. The other trailers and the straight trucks each have a tailgate rigidly suspended in a horizontal position. At retail stores having no loading platform, the tailgate is essential in unloading. The man who removes the groceries from the truck must have a place to stand and a place to put the merchandise.

Trip Routing

1. A large number of the errors in routing evidently stemmed from unfamiliarity of the routing supervisors with the specific routes involved. Although the 2 supervisors use rather elaborate maps in planning and scheduling the routes, changes are constantly being made in highways and city streets through new road construction, improvements in existing roads, closing of bridges for repairs, conversion of city streets from 2-way to 1-way traffic, changes in restrictions on truck traffic for certain city streets, etc. Route maps thus tend to become obsolete rather quickly. Because of these facts, the drivers should be encouraged to make suggestions as to changes in routing where such changes may result in a saving in time or distance traveled. This information could be written on the drivers' trip tickets, which are turned into the firm's office at the end of each trip. The suggested changes could then be evaluated and--if acceptable--would be incorporated in each of the routes.

2. Another means of reducing the routing errors would be for the 2 route supervisors to ride with the drivers from time to time and thus obtain familiarity with the delivery problems of each specific route.

3. The amount of overtime put in by delivery personnel on 5 of the 8 rural trips appears to be excessive. The adoption of the 2 recommendations cited would undoubtedly aid in reducing the overall delivery time for these trips. On the other hand, if the amount of overtime continues to be large, the possibility of readjusting the present routes or initiating an additional rural route should be investigated.

Loading and Unloading Procedure

1. All pieces should be numbered with the appropriate order number.

2. The number of pieces per order should then be written in at the bottom of the invoice sheet by the order-filling personnel.

3. Drivers should use the number on the package and the piece count to break down the order at each stop.

4. Drivers (in the case of straight trucks) and helpers (in the case of tractor-trailers) should use an item check inside the store with the storekeeper to insure the pieces are as represented on the invoice.

5. To insure against the chance of losing or damaging small items, a large carton should be placed near the tailgate of each truck at time of loading. Small items (properly numbered, as indicated above) should be dropped into it in rotation as each order is placed in the truck. These items may then be removed as each order is unloaded.

6. On all routes using both a driver and helper, the driver should break the load down at each stop while the helper moves the merchandise from the tailgate and hand-trucks or hand-carries it inside the buyer's establishment.

7. While the helper is inside checking the merchandise with the storekeeper (and collecting, in the case of a c.o.d. order), the driver should remain in the truck and break down the next order. Where it is necessary to level off the load after a stop, this should also be done by the driver.

8. If the driver completes the task of breaking down the next order and leveling off the load before the helper has returned from checking or collecting on the order, the driver should then close up the truck.

9. In the case of very large orders perhaps the above procedure would have to be varied to the extent that the driver, after breaking down the order in the truck, would assist the helper in moving the merchandise into the buyer's establishment. The driver could subsequently level off the load while the helper was checking the order or collecting, in the event of a c.o.d. order.

The above recommended method of breaking the orders down in the truck by package number and piece count was tested on 3 separate routes. Breaking the orders down by this method required approximately half the time by the item-by-item check. Several orders were broken down in an average of 7 seconds per

piece. In some instances, the item check which had been previously used ranged as high as 25 seconds per piece.

Significance of the Cost Data

The Baltimore wholesale firm is losing money delivering orders under $25 to rural areas. Average delivery costs for this group, comprising 5 percent of the total number of orders analyzed, exceed gross profit by approximately 10½ cents per dollar of sales. As previously mentioned, the firm's entire gross profit--averaged over a period of years--is reported as only 8 cents per dollar of net sales. Since all operating costs, including delivery expenses, must be deducted from gross profit before arriving at a net profit, the loss on these orders is especially heavy.

An additional 30 percent of the orders analyzed in the study were also undoubtedly delivered at a loss. These consisted of the 21 orders under $25 delivered in congested urban and other urban areas, and the 88 orders in the $25-$74.99 group delivered in rural areas. Inspection of the firm's profit-and-loss statements for recent years showed that its delivery expenses typically average only about 20 percent of the firm's total operating expenses. But in the case of the above mentioned 109 orders, the delivery expenses averaged 5 to 6 cents per dollar of sales, and thus accounted for two-thirds to three-fourths of the firm's gross profit. Even firms with a gross profit approximately twice that of the Baltimore wholesaler would find that delivery expenses of the magnitude of 5 cents or more per dollar of sales were disproportionately high.

The wholesaler needs to review carefully his deliveries of all orders under $25 and of rural orders in the $25-$74.99 group for the purpose of determining which of these should be eliminated. In his analysis of these deliveries, consideration should be given to the following points:

1. Selling small orders on a cash-carry basis only.

2. Consolidating each small customer's delivered orders, to make deliveries less frequent.

3. Encouraging the retailer to concentrate, with a single wholesaler, the purchases which are delivered to the retailer, instead of his spreading them out among several wholesalers. 7/

7/ On 1 of the rural routes, the author noted 3 different Baltimore wholesalers delivering dry groceries to a small country general store--located about 40 miles from Baltimore. As the wholesaler's truck in which the author was riding pulled up in front of the store to deliver a $20 order, another wholesaler's truck was just driving away. While the small order was being delivered, a third truck from another competitor drove up to deliver its order.

This can be done by means of a delivery charge on small orders or fixing a minimum size of order for delivery. Either practice could make an unprofitable customer into a profitable one or cause him to shift to another wholesaler. To part with him would be no loss.

In connection with this appraisal, the wholesaler should:

1. Determine which retailers who buy in small amounts are frequent buyers of substantial orders and hence might be allowed delivery of occasional small orders without a delivery charge.

2. Estimate the small customers' growth potential and possibly continue to deliver, in small quantities, without a delivery charge, to those who show promise of substantial early growth.

One large independent grocery wholesaler in a metropolitan area of an adjoining State handles his small order deliveries in the following manner: In 1954, he began a policy of refusing to deliver orders under $50, and established a separate delivery charge of $1.50 for all orders between $50 and $100. Recently he revised this policy and now has eliminated delivery service for all orders under $100.

Another way for the Baltimore wholesaler to reduce his delivery expenses is to increase his utilization of the load capacities of the 2 large tractor-semitrailer combinations. In 4 of the 5 trips which were made by these vehicles, only two-thirds of their capacity for hauling dry groceries was utilized.

Two approaches may be used in solving this problem: (1) A reallocation of customers is needed between routes requiring less than 8 hours and those requiring more than 9 hours. This would permit the carrying of larger loads on the routes that are now too short, and a saving of some overtime pay on the routes that are now too long. Because the wholesaler pays each driver or helper for a minimum of 43 hours of work per week, the best length of workday, from the wholesaler's standpoint, is between 8 and 9 hours. (2) The 2 large tractor-trailer combinations could be replaced by the smaller 12-ton capacity tractor-trailer combinations. This replacement could be done at the end of the useful service life of these vehicles.

To the extent that a reallocation of customers would make possible the elimination of 1 or more trips, this would be reflected in a decrease in the variable expenses. A reduction in both variable and fixed expenses would occur as a result of replacing the larger tractor-trailers--which cost more at the outset and in operation--with the smaller 12-ton capacity tractor-trailers.

As noted above, the wholesaler covered by this report is regarded as reasonably efficient in his operations by comparison to the trade as a whole. Nevertheless, the study has revealed this wholesaler's need for taking a careful

look at his delivery operations. The numerous errors in routing, inadequately designed delivery equipment, the lack of a uniform method of unloading, and the numerous small order deliveries are largely responsible for delivery expenses amounting to over 25 percent of the gross profit. Incorporating the previously mentioned recommendations should help to reduce the wholesaler's delivery expenses. Similar action would probably be sound business for many other food wholesalers. A reduction in operating costs in the wholesale grocery trade could in turn be reflected in higher prices to farmers and lower prices to consumers.

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